HEKIMIAN

MODEL 41-01

TRANSMISSION TEST SET

MODEL 41-01
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VICE MANUAL

HEKIMIAN LABORATORIES, INC.

SERVICE MANUAL
MODEL 41-01
TRANSMISSION TEST SET

Manufactured by

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TABLE OF CONTENTS

Section	Page
1. INTRODUCTION	1-1
1.1 General Description	1-1
1.2 Specifications	1-2
2. INSTALLATION	2-1
2.1 General	2-1
2.2 Installation	2-1
3. OPERATION	3-1
3.1 General	3-1
3.2 Controls and Indicators	3-1
3.3 Operating Adjustments	3-3
3.3.1 Receive Measurements	3-3
3.3.1.1 Receive Input Impedance	3-3
3.3.1.2 Level Measurement	3-3
3.3.1.3 Noise Measurement	3-3
3.3.2 Display Selection	3-4
3.3.3 Frequency Measurement	3-4
3.3.4 Audio Monitor	3-4
3.3.5 Generator	3-4
3.3.5.1 Continuous Mode	3-4
3.3.5.2 100.4 Hz Step Mode	3-5
3.3.5.3 1004 Hz Fixed Frequency Mode	3-5
3.3.5.4 Send Level Measurements	3-5
3.3.6 Rear Panel Connections	3-5
4. THEORY OF OPERATION	4-1
4.1 General	4-1
4.1.1 Level/Noise Meter	4-1
4.1.2 Frequency Counter	4-1
4.1.3 Generator and Clock	4-1
4.1.4 Power Supply	4-2

Section	Page
4.2 Detailed Circuit Operation	4-2
4.2.1 Level/Noise Meter	4-2
4.2.1.1 Input Circuit	4-2
4.2.1.2 Noise Filters	4-3
4.2.1.3 Level Measurement	4-3
4.2.1.4 Autorange Amplifier	4-3
4.2.1.5 Detectors	4-4
4.2.1.6 Log Converter	4-4
4.2.1.7 Digital Voltmeter	4-4
4.2.1.8 Monitor	4-5
4.2.2 Frequency Counter	4-5
4.2.3 Generator and Clock	4-6
4.2.3.1 Clock	4-6
4.2.3.2 Fixed Frequency Generator	4-6
4.2.3.3 Tuneable Generator	4-6
4.2.3.4 Output Amplifier	4-7
4.2.4 Power Supply	4-7
5. MAINTENANCE AND CALIBRATION	5-1
5.1 Maintenance Philosophy	5-1
5.2 Preventive Maintenance	5-1
5.2.1 General	5-1
5.2.2 Generator	5-1
5.2.2.1 1004 Hz Generator	5-1
5.2.2.2 Frequency Range	5-2
5.2.2.3 100.4 Hz Step	5-2
5.2.2.4 Generator Level Range	5-2
5.2.3 Frequency Counter	5-2
5.2.4 Audio Monitor	5-2
5.2.5 Receiver	5-2
5.2.5.1 Frequency Range	5-3
5.2.5.2 Level Range	5-3
5.2.5.3 3 kHz Filter	5-3
5.2.5.4 C-Message Filter	5-3
5.2.5.5 Notch Filter	5-4

Section	Page
5.3 Corrective Maintenance	5-4
5.3.1 Troubleshooting	5-4
5.3.2 Symptom Analysis	5-4
5.3.3 Circuit Level Troubleshooting	5-6
5.3.3.1 Power Supply	5-6
5.3.3.2 Crystal Oscillator and Dividers	5-7
5.3.3.3 1004 Hz Frequency Generator	5-7
5.3.3.4 Frequency Generator	5-7
5.3.3.5 100.4 Hz Step	5-8
5.3.3.6 Send Output Filters	5-8
5.3.3.7 Output Amplifier	5-8
5.3.3.8 Frequency Counter	5-9
5.3.3.9 Audio Monitor	5-9
5.3.3.10 Receive Input Amplifier	5-10
5.3.3.11 3 kHz Filter	5-10
5.3.3.12 C-Message Filter	5-11
5.3.3.13 Notch Filter	5-11
5.3.3.14 Autorange Amplifier	5-11
5.3.3.15 Detectors	5-11
5.3.3.16 Log Converter	5-12
5.3.3.17 Digital Voltmeter Controls	5-12
5.3.3.18 Digital Voltmeter Segment Drivers	5-12
5.3.4 Calibration	5-13
5.3.4.1 Power Supply	5-13
5.3.4.2 Low Frequency Set	5-13
5.3.4.3 Signal Purity Adjustment	5-13
5.3.4.4 1004 Hz Bandpass Filters	5-14
5.3.3.5 Notch Filter Alignment	5-14
5.3.4.6 C-Message Filter Alignment	5-15
5.3.4.7 600 Ω Calibration	5-15
5.3.4.8 900 Ω Calibration	5-15
5.3.4.9 Send Level Calibration	5-15
5.3.4.10 Noise Calibration	5-16

Section	Page
5.3.4.11 Level Detecting Calibration	5-17
5.3.4.12 Log Converter Calibration	5-17
5.3.4.13 Noise Detector Calibration	5-17

TABLES

Table	Page
1-1. Specifications	1-2
3-1. Controls and Indicators	3-2
5-1. Symptom Analysis	

MODEL ASSEMBLY INDEX

Description	Page
Mechanical Assembly	5-20
Chassis Sub Assembly	5-21
Heat Sink Sub Assembly	5-22
Receiver PC Board Assembly	5-23
Generator PC Board Assembly	5-30
Display PC Board Assembly	5-36
Switch PC Board Assembly	5-37

ILLUSTRATIONS

Figure	Page
1-1. Model 41-01 TRANSMISSION TEST SET	1-4
2-1. Model 41-01 Installation Dimensions	2-2
5-1. Model 41-01 Block Diagram	5-39
5-2. Receiver Component Layout	5-40
5-3. Receiver Schematic Diagram	5-41
5-4. Generator Component Layout	5-42
5-5. Generator Schematic Diagram	5-43
5-6. Display Component Layout	5-44
5-7. Display Schematic Diagram	5-45
5-8. Switch Component Layout	5-46
5-9. Switch Schematic Diagram	5-47
5-10. Interconnect Diagram	5-49
5-11. Frequency Generator Timing Diagram	5-51
5-12. Log Converter Timing Diagram	5-53

1. INTRODUCTION

1.1 General Description

The Model 41-01 TRANSMISSION TEST SET combines the functions of level, noise, and frequency measurements with a flexible signal generator in a compact, rack mounted instrument designed to fill a variety of fixed plant requirements. It features a high level of reliability, accuracy, and operating convenience.

Dual digital displays simultaneously present fully autoranged level or noise measurements with frequency readings from 40 Hz to 20 kHz. Indicating push-button controls are arranged for ease of operation and all variable controls have excellent resolution and setability. Independent selection of receive and send impedances and an audio monitor add to the unit's flexibility.

Level measurements are made directly in dBm using an average detector in compliance with Bell System standards. Noise measurements are made directly in dBrn using a quasi-RMS detector. C-message and 3 kHz flat weighting filters are front panel selected along with a 990 to 1030 Hz notch filter which meets the revised (1975) Bell System standards.

Frequency is measured on the second display and provides a dual range, 4-digit readout in kHz with 1 or 10 Hz resolution.

The flexible signal generator features continuous and stepped frequency coverage. For noise measurements, both a low distortion, crystal controlled 1004 Hz holding tone and a quiet termination are provided. To achieve high resoltuion and setability, the frequency and level controls are true 10-turn instrument potentiometers.

An audio monitor is provided to monitor the signal being measured.

The Model 41-01 is a rugged, compact instrument designed for rack mounted applications in a central office. The unit is powered by a self-contained power supply which draws 15 watts from either the commercial ac power line or a -24 V dc station battery. The test set is optionally available for a -48 V dc station battery. The power cord and fuse are located on the rear panel of the instrument.

1.2 Specifications

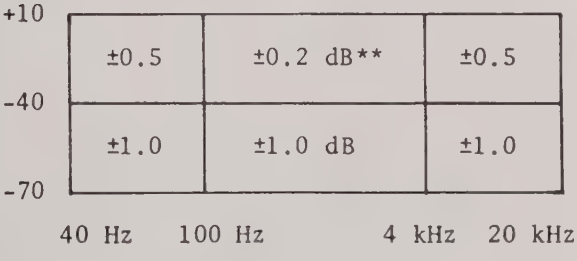
The electrical and mechanical specifications for the Model 41-01 are listed in Table 1-1.

A front view and a rear view of the Model 41-01 are shown in Figure 1-1.

TABLE 1-1

SPECIFICATIONS

GENERAL	
Measurements	Level (dBm, noise (dBrn), frequency (kHz)
Displays	Dual display, noise or level, and frequency
Generator	Sine wave, fixed and variable frequency, variable level
INPUT	
Impedance	600 Ω, 900 Ω, or bridged
Return Loss	>30 dB, 200 Hz to 20 kHz
Balance	>60 dB, up to 4 kHz
Line Holding	Resistive termination, 3 watts maximum
LEVEL MEASUREMENT	
Frequency Range	40 Hz to 20 kHz
Measurement Range	-80.0 dBm to +10.0 dBm, full autoranging
Accuracy	dBm



**±0.1 dB at 1000 Hz for levels between 0 and -19 dBm

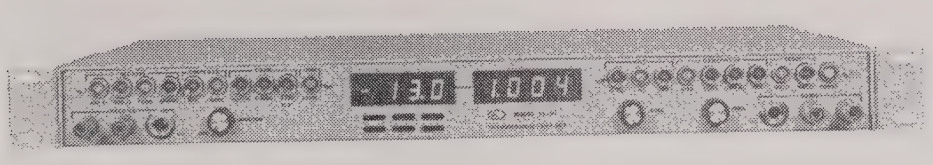
Detector Type	Average
NOISE MEASUREMENT	
Weighting Filters (Ref. Bell PUB 41009)	C-message 3 kHz flat Holding tone notch filter (995 to 1025 Hz)
Measurement Range	+10 dBrn to +100 dBrn
Accuracy	±1 dB, +20 dBrn to +100 dBrn
Detector Type	Quasi-RMS
FREQUENCY MEASUREMENT	
Frequency Range	40 Hz to 20 kHz
Level Range	-40 dBm to +10 dBm
Resolution/Update	1 Hz/2 times per second 10 Hz/10 times per second
Accuracy	±1 count

TABLE 1-1 (Cont)

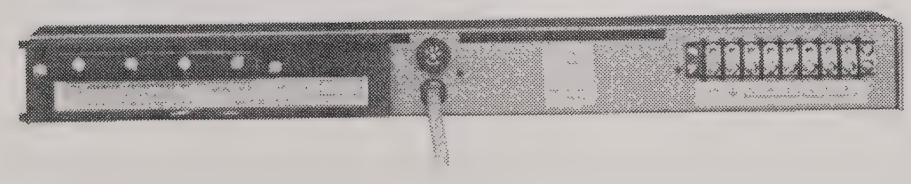
GENERATOR	
Frequency Range	200 Hz to 20 kHz
Modes	Continuous 100.4 Hz step* 1004 Hz OFF (Quiet termination)
Level Range	-40 dBm to +10 dBm, continuously adjustable
Distortion	>60 dB, 1004 Hz fixed >50 dB, 200 Hz to 4000 Hz >40 dB, 4000 Hz to 20 kHz
Impedance	600 Ω, 900 Ω, balanced
Return Loss	>30 dB, 200 Hz to 4000 Hz
CONNECTORS	
Front Panel	5-way binding posts, 310 jack*
Rear Panel	Screw-type barrier strip
POWER	100-130 V ac, 47-63 Hz, 15 watts or -24 V dc @ 600 mA*
SIZE	19" (48.25 cm.) W x 1-3/4" (4.45 cm.) H x 14-1/8" (35.88 cm.) D
WEIGHT	8.2 lbs. (3.7 kg.)
OPTIONS	-1. 220 V ac operation -11. -48 V dc operation -12. Optional input connectors -14. 100.0 Hz step in place of 100.4 Hz -15. 23" rack mounting -18. Remote display option

*See option list

HLI reserves the right to make changes in specifications at any time without notice.



FRONT VIEW



REAR VIEW

FIGURE 1-1. MODEL 41-01 TRANSMISSION TEST SET

2. INSTALLATION

2.1 General

The Model 41-01 TRANSMISSION TEST SET is designed for ease of operation and installation. After the unit has been removed from its shipping container, perform a complete visual inspection for possible damage. If damage is found, notify the carrier immediately; do not destroy any packing material until an agent of the carrier has examined it. Under U.S. shipping regulations, damage claims must be submitted by the consignee; do not return the instrument to Hekimian Laboratories, Inc., until a claim for damages has been established.

To inspect the unit's interior, remove the three screws at the bottom edge of each side of the unit. These hold the top cover which may then be removed and complete visual inspection performed.

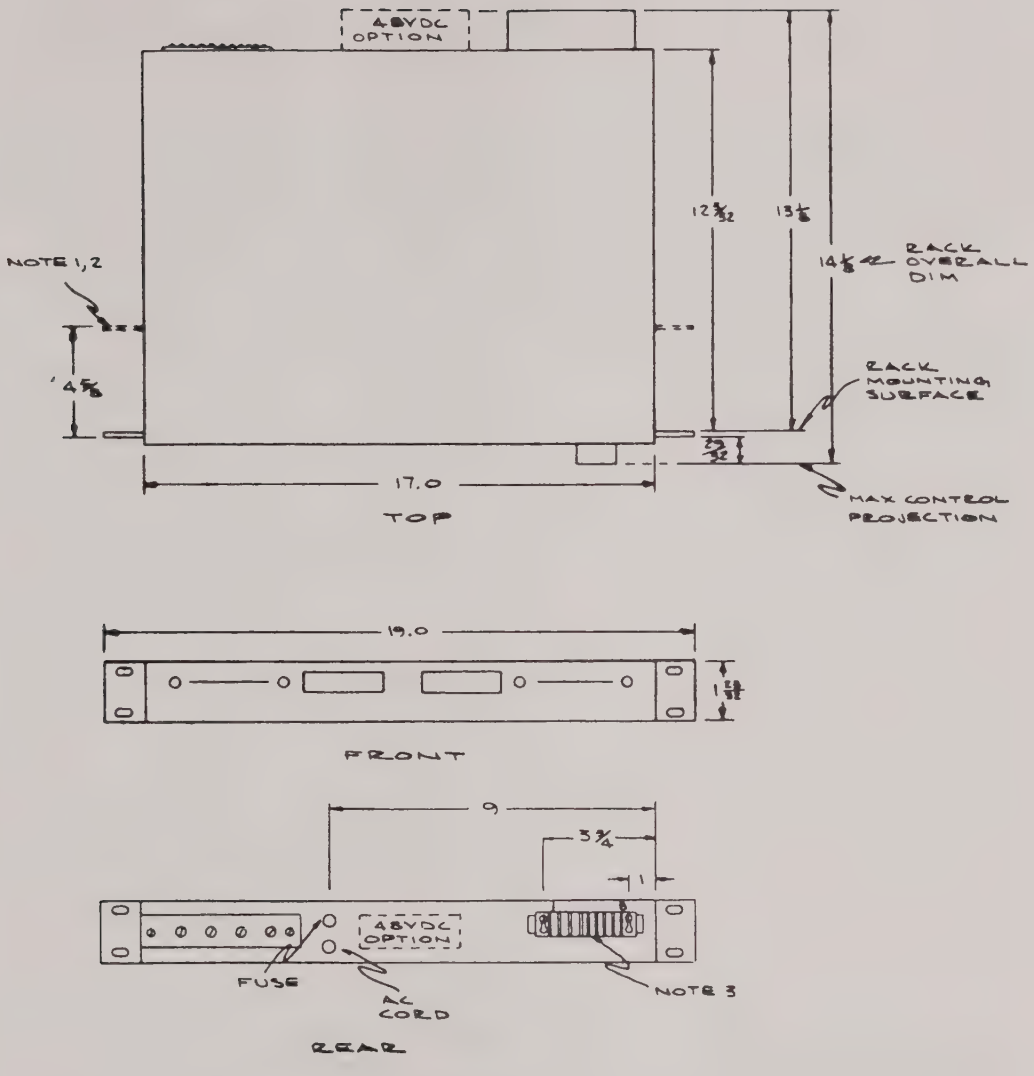
All internal adjustments have been set at the factory and no futher adjustments are required prior to installaiton or use of the equipment.

2.2 Installation

Power for the unit is supplied either from the ac power line via the line cord or from a -24 V dc station battery through the rear panel barrier strip. The line cord should be disconnected when the unit is operated on station battery. Check power supply polarity carefully. A reverse polarity may cause severe damage to the Model 41-01 power supply. The positive terminal of the -24 V input is connected to the chassis. Use only a floating 24 V supply or a positive ground supply.

Signal receive/send lines are connected to the front panel Western Electric 310 jacks, 5-way binding posts, or the rear panel barrier strip. Shielded cable is recommended for all signal connections. Ground connections for terminating cable shields are provided on the barrier strip.

Figure 2-1 shows overall mounting and dimensional data for the Model 41-01. Alternate mounting locations of the rack adapter ears are shown and may also be used for the 21" and 23" optional rack adapter. When rack mounting is not desired, the ears may be completely removed.



NOTES:

1. RACK MOUNTING EARS ARE DETACHABLE. MAY BE REMOUNTED IN LOCATIONS SHOWN.
2. RACK MOUNTING EARS AVAILABLE FOR 23" RACKS, AND 1 3/4" OR 1" RACK HEIGHT INCREMENTS.
3. REAR BARRIER STRIP CONNECTIONS:

TERM	FUNCTION
8	DC STATION BATTERY (-)
7	DC STATION BATTERY (GND)
6	SEND-OUTPUT-TIP
5	SEND-OUTPUT-RING
4	GND-SLEEVE
3	RECEIVER-INPUT-TIP
2	RECEIVER-INPUT-RING
1	GND-SLEEVE

4. ALL DIMENSIONS ARE IN INCHES

FIGURE 2-1. MODEL 41-01 INSTALLATION

3. OPERATION

3.1 General

This section contains a description of the controls and indicators, operation procedures, and methods of measurement to be used with the Model 41-01. Prior to operation, be sure that all connections to the instrument are made in accordance with instructions in Section 2.0.

The Model 41-01 Block Diagram is shown in Figure 5-1. Signal flow is from left to right. The generator section consists of a crystal controlled 1004 Hz test tone and a continuously variable, voltage controlled oscillator which may be frequency locked at 100.4 Hz intervals. The desired mode of operation is selected by the front panel pushbutton switches. The desired signal is then fed to the send amplifier whose amplitude is controlled by the front panel generator level control.

The receiver can be selected to measure either level or noise, with or without holding tone. When a desired mode has been selected, the signal is then fed to the autorange amplifier, detectors and digital voltmeter. Connections are also made to the frequency counter and audio monitor amplifier.

The master clock consists of a crystal controlled 2 MHz oscillator from which all other timing pulses are derived. This oscillator is also used to derive the fixed 1004 Hz test tone.

3.2 Controls and Indicators

The controls and indicators used in operation of the Model 41-01 are described in Table 3-1. All controls are located on the front panel and are shown in Figure 1-1. No internal adjustments are required during normal operation.

TABLE 3-1

CONTROLS AND INDICATORS

Designation	Function
RECEIVE Pushbutton Switches	Selects either 600 Ω or 900 Ω impedance, terminated or bridged modes and sets the dBm reference impedance for the input.
DISPLAYS Pushbutton Switches	Selects either the receive or send signals to be monitored and displayed on the level meter and frequency counter.
DBRN Pushbutton Switches	Selects either the C-message or 3 kHz flat weighting fitlers with or without the notch filter. When either of the noise weighting filters is selected, a quasi-RMS detector is used and the level meter displays dBrn directly.
DBM Pushbutton Switches	Selects the average detector used for flat response and level measurements and causes the level meter to display level directly in dBm.
KHZ Pushbutton Switches	Selects either the fast or slow update mode of the frequency counter and allows the display to be blanked during noise measurement.
GENERATOR Pushbutton Switches	Selects the desired generator mode.
FREQ Control	Selects the desired frequency in continuous or 100.4 Hz stepped mode of operation.
LEVEL Control	Sets the desired output level.
SEND Pushbutton Switches	Selects either 600 Ω or 900 Ω impedance and sets the dBm reference for the generator.
POWER Pushbutton Switch	Controls the power to the instrument.
MONITOR Control	Controls the level of the monitor speaker.

3.3 Operating Adjustments

This section presents the operational adjustment used with the Model 41-01. Connections to the send and receive terminals should be made in accordance with instructions given in Section 2.

3.3.1 Receive Measurements

This section contains the detailed operational instructions to be used for the level meter. To monitor and display the input signal, depress the display button marked REC.

3.3.1.1 Receive Input Impedance

Select the receiver reference impedance by depressing either the 600 Ω or 900 Ω pushbutton. Select either the terminated or bridged mode by depressing either the TERM or BRIDGE pushbutton.

3.3.1.2 Level Measurement

When the receive input impedance has been properly selected, depress the DBM pushbutton switch. This selcts the average detector and indicates level directly in dBm referenced to the selected receive input impedance.

The range of level measurement is -80.0 to +10.0 dBm. When the input is above or below this range, the display numbers will go blank leaving an illuminated + sign when the input is above +10 dBm or a - sign when it is below -80 dBm.

3.3.1.3 Noise Measurements

Message circuit noise is measured by depressing either the C-MSG or 3 KHZ FLAT pushbutton. The NOTCH pushbutton may be depressed if a 995 Hz to 1025 Hz holding tone is being used for noise with tone measurement. All noise measurements are read out directly in dBrn.

The range of noise measurements is +10 to +100 dBrn. When the input is above or below this range, the display numbers will go blank leaving an illuminated + sign when the input is above +100 dBrn or a - sign when it is below +10 dBrn.

3.3.2 Display Selection

Either the send or receive signal level and frequency may be measured by depressing the proper DISPLAYS pushbutton. The display pushbuttons select the input to the level meter, frequency counter, and audio monitor. In the SEND mode, the noise weighting filters are bypassed so only an absolute send level reading is displayed.

3.3.3 Frequency Measurement

The input to the frequency counter is controlled by the DISPLAYS pushbutton. Frequency resolution and update rate are controlled by the KHZ FAST and SLOW pushbuttons. In the 1 Hz mode, the resolution is 1 Hz and the update rate is 2 per second. In the 10 Hz mode, the resolution is 10 Hz and the update rate is 10 per second.

In the 1 Hz mode, frequencies from 40 Hz to 9.999 kHz may be measured. Frequencies above 9.999 kHz will cause the display to flash, indicating an overrange condition. The 10 Hz mode measures frequency from 40 Hz to above 20 kHz. If the frequency display is all zeros when the 10 Hz or 1 Hz range has been selected, the receive input level is below approximately -45 dBm.

The KHZ OFF pushbutton is provided so that the display may be blanked if desired during noise measurement.

3.3.4 Audio Monitor

Input to the audio monitor is controlled by the DISPLAYS pushbuttons. The level of the audio monitor is controlled by the front panel MONITOR control.

3.3.5 Generator

This section contains the detailed operational instructions to be used for the Model 41-01 generator. To measure the generator frequency and level, depress the display pushbutton marked SEND. Select the desired output impedance by depressing either the 600 Ω or 900 Ω SEND pushbutton.

3.3.5.1 Continuous Mode

Depress the generator pushbutton marked CONT. Use the FREQ and LEVEL controls to adjust for the proper output as indicated on the Model 41-01 displays.

3.3.5.2 100.4 Hz Step

Depress the generator pushbutton marked STEP. The FREQ control will now adjust the output frequency in 100.4 Hz steps. With the 100.0 Hz step option the output frequency varies in 100 Hz steps.

3.3.5.3 1000 Hz Fixed Frequency Mode

Depress the generator pushbutton marked 1004 HZ. This selects the crystal controlled 1004 Hz test tone. Output level is adjusted using the LEVEL control.

3.3.5.4 Send Level Measurements

In accordance with telephone company transmission level measurement practices, the SEND level measurement is calibrated in terms of the level that will exist at the SEND terminals when they are properly terminated in the impedance selected by the SEND pushbutton switches. If the actual terminating impedance is different than the selected impedance (600 Ω or 900 Ω), send levels other than that indicated will exist at the SEND terminals. The actual level across the SEND terminals may be verified using an external meter or temporarily bridging the Model 41-01 receive input (in the BRIDGE mode) across the SEND terminals. The receive impedance should be the same as the send impedance.

3.3.6 Rear Panel Connections

The rear panel mounted terminal block is provided for connection of input leads, output leads and 24 V station battery. The positive terminal of the 24 V input is connected to the chassis. Use only a floating 24 V supply or a positive ground supply. A reverse polarity may cause damage to the Model 41-01.

When the 24 V station battery is being used, the ac line cord should be disconnected.

4. THEORY OF OPERATION

4.1 General

This section provides a general theory of operation followed by detailed circuit operation on a functional block basis. The Model 41-01 is entirely solid state and makes extensive use of intergrated circuit operational amplifiers and CMOS digital logic circuits. Discussions of conventional transistor circuitry, operational amplifier theory and digital logic circuitry are available in a number of current reference tests. The Model 41-01 Block Diagram shown in Figure 5-1 is discussed in the following sections.

4.1.1 Level/Noise Meter

The input circuitry bridges or terminates 600 and 900 Ω receive lines. This input signal is then transformer coupled to the input amplifier which is directly connected to the autoranging circuitry for level measurements and drives the 1010 Hz notch and C-message/3 kHz weighting filters for noise measurements. The autorange circuitry, which may monitor either the receive or send signals, automatically adjusts the amplifier gain to keep the received signal level within the range of the noise and level detectors. The dc output of the selected detector is applied to the log converter. The log converter changes the linear voltage output of the detectors to a logarithmic output to allow a display of the level and noise directly in dB. The digital voltmeter takes the output of the log converter and control signals from the autorange amplifier and converts these to the 3-digit digital display of noise and level.

A front panel controlled monitor speaker is also provided which allows the operator to audibly monitor the input signal.

4.1.2 Frequency Counter

A 4-digit frequency counter with selectable 1 Hz or 10 Hz resolution monitors the signal applied to the level/noise meter. The counter uses a large scale integration (LSI) CMOS IC to perform the frequency counting operation and drive the 4-digit multiplexed display.

4.1.3 Generator and Clock

The tuneable frequency generator uses a voltage controlled oscillator (VCO) operating at 40 times the output frequency to drive a low distortion stairstep sine-wave generator. The generator output is processed by four

programmed filters to provide excellent spectral purity. Continuous frequency control or locked 100.4 Hz (100.0 Hz) steps using frequency lock circuitry in the VCO may be front panel selected.

A separate fixed frequency divider and 2-pole 1004 Hz bandpass filter generates a high stability, high purity 1004 Hz holding tone.

The selected generator signal is applied to the send amplifier where the output level is controlled and then to the output driver which transformer couples the selected generator signal at either a 600 Ω or 900 Ω impedance level to the send terminals.

A 2 MHz master clock oscillator is used to generate the various clock, control, updating and locking frequencies required in the operation of the level/noise meter, frequency counter and generator sections. The master clock is crystal controlled.

4.1.4 Power Supply

The power supply provides the ±9 V and +5 V used in the Model 41-01. The supply is designed to operate directly from a -24 V external dc source or from the 115 V ac line using a transformer and bridge rectifier to supply an internal 24 V dc. All voltages are electronically regulated for accuracy and long term stability with temperature and line voltage fluctuations.

4.2 Detailed Circuit Operation

The following sections describe the detailed circuit operations for the level/noise meter, frequency counter, generator and clock and power supply. Schematics and timing diagrams are presented in Section 5.

4.2.1 Level/Noise Meter

4.2.1.1 Input Circuit

The input signal is connected to the front panel Western Electric 310 jack or 5-way binding posts. It is then routed to the 41-400 board which contains the dc isolation capacitors C1, C2, the TERM switch S3, and the 600/900 Ω terminating resistors and selection switches. The signal is then routed through interconnecting cable FC1 to the 41-100 board where it is transformer coupled to the input amplifier IC1. The wideband, low noise unity gain op/amp drives the level and noise filter circuitry.

4.2.1.2 Noise Filters

The input amplifier IC1 drives the 4-pole notch filter IC5, IC6, IC7, and IC8. This filter makes use of four active notch filters with leapfrog feedback for overall stability. The notch design has a passband loss of approximately 6 dB and each pole is provided with individual frequency and depth adjustments.

The 3 kHz flat filter IC2A and C-message filter IC2B, IC3, and IC4 use conventional active filter techniques to generate these noise weighting characteristics.

The input amplifier and notch filter outputs and the 3 kHz and C-Message inputs/outputs are routed to the 41-400 board where the notch in/out is selected by the NOTCH switch S7 and isolated by amplifier IC1. The input signal with or without the notch is connected to the weighting filters whose output are selected by the C-MSG and 3 KHZ FLAT switches S8 and S9.

4.2.1.3 Level Measurement

The LEVEL switch S10A of PCB 41-400 selects either the noise signal or level signal for routing to the FET gate Q1 on the 41-100 board. The send signal is connected to FET gates Q3, Q22 which provide both a transmission gate and short to ground to minimize send signal crosstalk.

The 600 Ω and 900 Ω gain adjustment is controlled by switches S1, S6, and S18. The control signal is fed to the FET gain control transistor Q4 on PCB 41-100 which controls the gain of the autoranging input amplifier IC9.

4.2.1.4 Autorange Amplifier

The autorange amplifier accepts the noise, receive level or send level signal and adjusts its gain in 20 dB steps to keep the signal level within the detector operating range.

The autorange amplifier consists of three cascaded 20 dB gain amplifier stages with individual FET gates to select the desired amplifier output. The first 20 dB gain amplifier IC9 also includes the 600/900 Ω gain adjustment circuit. The following three amplifiers IC10, IC11, and IC15 are identical and include a 20 dB gain amplifier stage with dc blocking, level detector diodes, a detector amplifier and a transistor logic gate which in conjunction with the other amplifiers opens the proper FET gate Q10, Q11, Q12, or Q13 to connect the output to the signal detector circuitry. Logic diodes D17, D18, D19, and D20 and driver transistors Q5, Q6 generate the range

control signals for the digital display so that it matches the selected range of the autorange amplifier.

4.2.1.5 Detectors

The autorange amplifier output is buffered by unity gain amplifier IC14 which applies a signal to the quasi-RMS detector used for noise detection and the average signal detector used for level detection. The detectors use a common full wave rectifier circuit IC14A, IC12A which provide individual outputs for the average detector IC12B and the quasi-RMS detector IC13B. Both detectors incorporate dc bias adjustments and the average detector has gain adjustment.

The detector outputs are routed to the 41-400 switchboard where the LEVEL switch S10B selects the proper detector for the selected measurement.

4.2.1.6 Log Converter

The log converter is located on the 41-200 board and takes the detected signal output and converts it to a gated clock signal whose duration is proportional to the logarithm of the input.

Capacitor C2 is charged to the detector output level through IC39. Every 320 ms the capacitor is disconnected from the detector and allowed to discharge to the reference voltage set by diode D1 and the voltage follower IC2B. The discharge period is converted to a sharp pulse by transistors Q4, Q5, and Q7. This pulse is synchronized with the 100 kHz clock by flip-flop IC6 to prevent partial clock pulses.

4.2.1.7 Digital Voltmeter

The gated clock output from the log converter, the range information from the autoranging amplifier, the update clock and unit (dBm, dBrn) control signals are processed by the digital voltmeter on the 41-100 board to provide a 3-digit plus sign level and noise readout directly in dBm/dBrn.

The number to be displayed is accumulated in the four pre-set decade counters IC25, IC26, IC27, and IC28. These counters take the gated clock pulse from the log converter and accumulate the hundredths, tenths, units and tens digits. The pre-set circuitry takes the range information from the autoranging amplifier and pre-sets the counters to the correct 20 dB range. Two sets of pre-set numbers are used: one for dB level measurements and the other for dBrn noise measurements. The output of the pre-set counters are fed to the display latches IC29, IC30, and IC31 which drive the 7-segment displays

located on the 41-300 board. Overrange blanking is controlled by the overrange detectors IC16A, IC16B which process the range and level information from the autoranging amplifier and the detector outputs to determine overrange/underrange conditions. The remaining digital logic provides half digit and polarity displays, control of the decimal point, and blanking of the tenths dB digit during noise measurements.

4.2.1.8 Monitor

The level or noise signal selected for display may also be monitored with the internal monitor amplifier and speaker.

The monitor signal is obtained from the output of the input amplifier of the autorange amplifier. It is routed to the 41-400 board and the front panel monitor gain control R2. This control is connected to the monitor amplifier IC1 and the monitor driver transistors Q1, Q2. These transistors provide a low impedance drive directly to the monitor speaker.

4.2.2 Frequency Counter

The frequency counter provides a 4-digit display with front panel switch selected 1 Hz or 10 Hz resolution. It makes use of a large scale integrated (LSI) counter IC with multiplexed display and the necessary external circuitry to provide analog signal processing, gating, reset/updating and leading zero suppression. It is located on the 41-200 board.

The counter analog signal input is derived from the third stage of the autoranging amplifier and is converted to logic levels in input amplifier IC16. This signal is run through differentiators C7, R31 and C8, R33 so that each zero crossing provides a pulse which effectively doubles the input frequency allowing display updates of 2/s rather than the 1/s which is commonly provided for 1 Hz resolution. The input to C8, R33 is disabled when 10 Hz resolution is used.

A 100 Hz clock signal is processed by counter IC19, the gate circuits IC18 and flip-flop IC20B to provide either the 1 Hz or 10 Hz resolution count gate selected by the front panel switch S11. Reset and update pulses are generated by the gates IC21, IC22, and IC23 with their corresponding RC time constants. Leading zero suppression is provided by flip-flop IC20 and the logic gates IC21, IC23.

The counter display may be turned off using the OFF front panel switch S13.

4.2.3 Generator and Clock

4.2.3.1 Clock

The clock circuitry located on the 41-200 board uses a 2 MHz crystal oscillator Y1, IC7 and a divider chain IC6, IC8, IC9, IC10 to provide the 500 kHz clock to the fixed frequency divider circuitry, the 100 kHz clock to the log converter, the 100 Hz clock to the frequency counter and generator lock circuitry and the 3.125 Hz update signal to the log converter and digital voltmeter.

The 2 MHz clock frequency may be adjusted using trimmer C6.

4.2.3.2 Fixed Frequency Generator

The fixed frequency generator provides the high accuracy, low distortion 1004 Hz holding tone available from the generator section. It is located on the 41-200 board.

A feedback counter arrangement using counter IC11 and digital gates IC12, IC13 divides the 500 kHz clock signal by 249. A final divide by 2-stage IC14 provides a symmetrical square wave to the 2-pole bandpass filter IC15. The filters provide better than 60 dB harmonic rejection providing a high purity sine wave at 1004.016 Hz. The filter output is fed to the 1004 HZ switch S16A of the 41-400 board which is used to select the desired generator output.

4.2.3.3 Tuneable Generator

The tuneable generator uses a frequency locked oscillator, 100.4 Hz lock circuitry, a waveform generator and switchable filters to generate the variable frequency generator signal. It is located on the 41-200 board.

The frequency locked oscillator, IC26, operates at 20 times the generator output frequency and covers the range from 4 kHz to 400 kHz. An internal phase detector together with R58 and C19 doubles the oscillator output frequency by providing a pulse for each zero crossing. Its output is changed to a BCD number by the counter IC30 which drives the BCD to decade decoder IC32. The decoder outputs drive a precision resistor network which generates, as a result of the up/down counter operation, a 20 step replica of a positive half sine wave. This stairstep replica is buffered by amplifier IC33B. This amplifier is switched from the inverting to the non-inverting configuration by two transmission gates under the control of divider flip-flop IC31.

The switchable filter IC25 filters the stairstep sine wave to provide a smooth low distortion sine wave. Four filter bandwidths are selected by the transmission gates controlled by the threshold detectors, IC28 and IC34. These threshold circuits monitor the frequency locked oscillator dc control voltage, which is proportional to frequency, to control the range over which each filter bandwidth is used.

The frequency locked oscillator may be tuned continuously using the front panel STEP switch S14. In the locked mode, the 100.4 Hz clock signal is buffered by amplifier IC25 and samples the sine wave generator output in transmission gate IC37. In the locked mode, this signal is summed through transistor Q16 with a voltage proportional to the frequency locked oscillator frequency derived by the charge pump discriminator IC27A, integrated by integrator IC27B, and applied to the oscillator frequency control input.

4.2.3.4 Output Amplifier

The 1004 Hz fixed or tuneable generator output is selected by the 1004 Hz switch S16B on the 41-400 board. The signal is then applied to the front panel generator send level control R4 which is connected to the output amplifier IC38 on the 41-200 board to give a logarithmic control of output level over approximately a 25 dB range. This signal is coupled to the final output amplifier IC40 which provides the transformer coupled balanced output signal to the impedance determining networks and dc isolation capacitors on the 41-400 board.

The send level measurement signal and adjustment are provided after output amplifier IC38 and the SEND 600 Ω selector switch S18 provides the impedance level information to the autoranging circuitry for send level measurements.

4.2.4 Power Supply

The power supply is located on the 41-200 board and derives all the supply voltages from a -24 V dc source, the 115 V ac line or a -48 V dc source (optional).

The power supply is designed to operate from a positive ground -24 V dc source. This may be supplied externally from station battery or internally (ac operation) through transformer T1 located on the chassis and rectifier D19 and capacitor C38. To provide the positive and negative supply voltages required for the op/amps, a floating ground is derived from the 24 V supply.

The IC regulator IC41 and pass transistor Q21 regulate the -24 V to -18 V supply voltage which is used as the floating signal ground. Transistors Q22, Q23 provide additional current capacity for the floating ground.

The 5 V regulator IC42 and its pass transistor Q24 are referenced to the floating ground and provide the regulated +5 V used by the displays and digital logic.

The floating ground system does not affect measurements made by the test set because all input/output signals are transformer coupled. When using conventional test equipment to calibrate or troubleshoot the Model 41-01, the test equipment connections described in Section 5 should be followed to prevent shorting of the chassis ground to the floating ground.

When direct operation from a -48 V station battery is required, an optional pre-regulator is used. This pre-regulator consisting of a pass transistor and a Zener voltage reference diode regulates the 48 V supply to 24 V which is applied to the normal power supply input. Heat dissipation for the pre-regulator is provided by the optional heat sink bolted to the rear of the Model 41-01.

5. MAINTENANCE AND CALIBRATION

5.1 Maintenance Philosophy

Maintenance procedures for the Model 41-01 are divided into preventive and corrective classifications. Preventive maintenance consists of a routine performance check which may be made using the front panel controls of the instrument. Corrective maintenance covers the symptom analysis, trouble-shooting, repair and recalibration of the instrument.

5.2 Preventive Maintenance

5.2.1 General

The preventive maintenance procedures described in the following sections are used by the operator and the maintenance personnel to verify proper instrument operation using the front panel controls. If proper operation is not achieved, see Section 5.3 for corrective maintenance procedures.

Periodic cleaning, lubrication or inspection of the Model 41-01 is not required.

The following checks are made by looping the Model 41-01 output to the Model 41-01 input. Connections between the output and input terminals may be made using an appropriate test cord.

5.2.2 Generator

This section contains the self-checks that may be used for the generator section of the Model 41-01. If proper operation of the Model 41-01 receiver section is in doubt, an external frequency counter and voltmeter may be used to check the generator.

5.2.2.1 1004 Hz Generator

Starting from left to right, depress the following Model 41-01 pushbuttons: 600 Ω, TERM, REC, C-MSG, 1 HZ, 1004 HZ, and 600 Ω. Connect the input and output terminals together with an appropriate test cord. Using the send level control, adjust the output for a reading of +90 dBrn on the Model 41-01. The counter should indicate a frequency of 1.004 kHz ±1 Hz. Depress the NOTCH pushbutton and verify that the Model 41-01 reads less than +40 dBrn.

5.2.2.2 Frequency Range

Depress the dBm pushbutton marked LEVEL and the generator pushbutton marked CONT. Using the front panel frequency control knob, vary the frequency over its entire range and verify that the frequency range covers at least 200 Hz to 20 kHz.

5.2.2.3 100.4 Hz Step

Depress the generator pushbutton marked STEP. Using the front panel frequency control, vary the frequency from the range 200 Hz to 20 kHz and verify that the frequency changes in 100.4 Hz steps.

5.2.2.4 Generator Level Range

Depress the generator pushbutton marked 1004 HZ. Using the front panel LEVEL control knob, vary the level over its range and verify that the send level includes the range +10.0 dBm to -40.0 dBm.

5.2.3 Frequency Counter

Depress the 1 HZ pushbutton. Using the Model 41-01 generator, vary the frequency from 200 Hz to 10 kHz and verify that the frequency counter follows the generator output.

Depress the 10 HZ pushbutton. Using the Model 41-01 generator, vary the frequency from 10 kHz to 20 kHz and verify that the frequency counter follows the generator output.

Depress the frequency counter OFF pushbutton and verify that the display blanks.

5.2.4 Audio Monitor

Depress the display pushbutton marked SEND and the generator pushbutton marked 1004 HZ. Using the front panel LEVEL control knob, adjust the send level for a reading of 0.0 dBm on the Model 41-01. Adjust the MONITOR level control and verify the presence of a 1004 Hz tone from the speaker. The speaker output should increase in level as the MONITOR control is turned clockwise.

5.2.5 Receiver

This section contains the various checks for the receive section of the Model 41-01. Once proper operation of the generator section has been verified, the Model 41-01 generator may be used as the input signal to the Model 41-01 receiver.

5.2.5.1 Frequency Range

Depress the receive pushbuttons marked 600 Ω and TERM, the display pushbutton marked REC, DBM pushbutton marked LEVEl, the KHZ pushbutton marked 1 HZ, the GENERATOR pushbutton marked CONT, and the SEND pushbutton marked 600 Ω. Using the front panel frequency control knob, adjust the generator frequency for a frequency of 1000 Hz ±10 Hz. Using the front panel level control, adjust the generator output level to 0.0 dBm. Using the frequency control knob, adjust the frequency for 200 Hz to 4 kHz and verify that the Model 41-01 display indicates 0.0 ±0.3 dB. Vary the frequency from 4 kHz to 20 kHz and verify that the Model 41-01 display indicates 0.0 ±0.3 dB. Vary the frequency from 4 kHz to 20 kHz and verify that the Model 41-01 indicates 0.0 dB ±0.5 dB.

5.2.5.2 Level Range

Place an external attenuator with an overall accuracy of 0.1 dB or better between the send output and the receive input. Set the input to 0.0 dBm at a frequency of 1000 Hz ±10 Hz. Vary the input level over the range of +10.0 to -40.0 dBm and verify that the Model 41-01 indicates a correct level ±0.2 dB. Vary the input level over the range of -40.0 to -70.0 dBm and verify that the Model 41-01 indicates the correct level ±1.0 dB.

5.2.5.3 3 kHz Filter

With the NOTCH pushbutton out and the 3 KHZ pushbutton in, adjust the Model 41-01 receiver input to a frequency of 1000 Hz ±10 Hz. Adjust the level so that the Model 41-01 display flashes between +89 and +90 dBrn. Without changing the input level, change the input frequency to 3000 ±10 Hz and verify that the Model 41-01 display indicates +87 dBrn ±1 dB.

5.2.5.4 C-Message Filter

With the NOTCH pusbbutton out and the C-MSG pushbutton in, adjust the frequency to 1000 Hz ±10 Hz. Adjust the level so that the Model 41-01 display flashes between +89 and +90 dBrn. Without changing the input level, change the input frequency to 3700 ±20 Hz and verify that the Model 41-01 display indicates a level of +80 dBrn ±2 dB.

5.2.5.5 Notch Filter

Depress both the NOTCH pushbutton and the C-MSG pushbutton. Set the receive input to a frequency of 2000 Hz ±10 Hz at a level of +90 dBrn. Without changing the level, change the input frequency to 1000 Hz ±10 Hz. Verify that the Model 41-01 indicates a level of +40 dBrn or less.

5.3 Corrective Maintenance

5.3.1 Troubleshooting

This section covers symptom analysis, circuit level troubleshooting and calibration procedures for the Model 41-01.

No specialized mechanical assembly or disassembly procedures are required. Accepted practices should be followed when repair is undertaken on mainframe components or the printed circuit boards. Recommended troubleshooting techniques are based on signal tracing methods where a known input signal is used and the level and waveforms are verified as the signal progresses through the circuitry.

5.3.2 Symptom Analysis

The preventive maintenance checks of Section 5.2 are used to isolate the area in which malfunction occurs. Table 5-1 summarizes possible fault location for each of the preventive maintenance tests.

TABLE 5-1

SYMPTOM ANALYSIS

Preventive Maintenance Test	Probable Trouble Location
1. No response from any test	a. Ac power cord b. Fuse c. Internal ac wiring or power switch d. Power supply
2. 1004 Hz generator check (5.2.2.2)	a. Output amplifier IC38 or IC40 b. Divider IC29, IC30, IC31 c. 1004 Hz divider IC12, IC13, or IC11 d. Crystal oscillator or divider IC6, IC7, IC8, or IC9 e. 1004 Hz switch S16

TABLE 5-1 (Cont)

Preventive Maintenance Test	Probable Trouble Location
3. Generator frequency check (5.2.2.2)	a. VCO IC26 b. Divider IC29, IC30, IC31 c. Sine wave converter IC32, IC33 d. Output filters IC25, IC35, IC36, IC37 e. Discriminator IC27 f. VCO control IC28, IC34
4. 100.4 Hz step test (5.2.2.3)	a. 100.4 Hz input IC25, IC37 b. 100.4 Hz lock IC27, Q6
5. Level range check (5.2.2.4)	a. Output amplifier IC38, IC40 b. Output transformer T1
6. Frequency counter check (5.2.3)	a. Input or autorange amplifiers IC1, IC9, IC10, IC11, IC15 b. Input IC9 or Q4 on 41-100 board c. 10 Hz resolution D9, D10, IC17 d. Counter control IC17 through IC24 e. Digit drivers Q11 through Q14, IC24 f. Segment drivers Q15 through Q20, Q8
7. Audio monitor check (5.2.4)	a. Input amplifier IC1 b. Summing amplifier IC9 c. Monitor amplifier IC1, Q1, Q2 on 41-400 board
8. Receive frequency range check (5.2.5.1)	a. Input amplifier IC1 b. Autorange amplfier IC9, IC10, IC11, IC15 c. Detectors IC12, IC13, IC14
9. Receiver level check (5.2.5.2)	a. Autorange amplifier IC9, IC10, IC11, IC15 b. DVM control IC18, IC19, IC21, IC33, IC35, IC22 c. DVM counters IC24 through IC34
10. 3 kHz filter check (5.2.5.3)	a. 3 kHz filter IC2A b. Noise amplifier IC1 on 41-400 board
11. C-message filter check (5.2.5.4)	a. C-MSG filter IC2B, IC3, IC4 b. Noise amplifier IC1 on the 41-400 board
12. Notch filter check (5.2.5.5)	a. Notch filter IC5, IC6, IC7, IC8 b. Filter switches S7, S8, S9

5.3.3 Circuit Level Troubleshooting

The following sections describe the general procedures to be used in locating malfunctions. Where appropriate, performance standards, voltage levels, or waveform descriptions are provided to assist in the troubleshooting procedure. Unless otherwise stated, all voltage and frequency tolerances are ±10% and all dB tolerances are ±0.1 dB. When a circuit has the proper input signal, but the correct output cannot be measured, the components associated with that circuit should be checked and replaced if defective. Before detailed troubleshooting is undertaken, the ±9 V power supply voltages should be checked. Low supply voltages may result from a malfunctioning power supply or excessive current being drawn by a defective circuit. A defective integrated circuit may often be located by feeling the case temperature. Normally, the integrated circuits are moderately warm to the touch. However, when defective, they can become extremely warm, causing a painful sensation when touched.

The local system ground used in the Model 41-01 is not at the same potential as chassis or earth ground. For this reason floating test equipment should be used. When floating test equipment is not available, the unit must be operated on the ac line supply, and the black wire connected to the + terminal on the 41-200 board must be disconnected. Connection to the local ground can be made at the junction of the negative terminals of C42 and C44 toward the rear of the 41-200 board.

5.3.3.1 Power Supply (41-200 Board)

Using a dc voltmeter, measure the voltage from the negative end of C46 to the positive end of C44. This voltage should be 18.0 V dc ±0.5 V. If the correct voltage is not present, then IC41 is most likely defective.

If the correct voltage is present, monitor the voltage across C44 and C46. This voltage should be 9.0 V dc ±0.3 V dc. If the correct voltage is not present, then IC43, Q22, or Q23 is defective.

Monitor the voltage across capacitor C42. This voltage should be 5.0 V dc ±0.1 V dc. If this voltage is not present, disconnect the jumper wire connecting the 5 V supply to the pc board. If the correct voltage is not present, then IC42 or Q24 is most likely defective. If the correct voltage is present, then there is most likely a malfunction on the pc board that is loading down the power supply.

5.3.3.2 Crystal Oscillator and Dividers (41-200 Board)

Using an oscilloscope with a calibrated time base, monitor the signal at Pin 12 of IC6 on the 41-200 board. This signal should be a 1 MHz, 5 V square wave. If this signal is not correct, check the 2 MHz oscillator IC7 or the divide by two IC6.

Monitor the signal at Pin 5 of IC8. This signal should be a 5 V square wave with a duty cycle ratio of 40/60 and a frequency of 100 Hz.

Monitor the signal at Pin 13 of IC8. This signal should be a 5 V square wave at a frequency of 10 kHz and a duty cycle ratio of 40/60.

Monitor the signal at Pin 13 of IC9. This signal should be a 5 V square wave at a frequency of 100 Hz and a duty cycle ratio of 40/60.

Monitor the signal at Pin 14 of IC9. This signal should be a 5 V square wave at a frequency of 100 Hz and a duty cycle ratio of 20/80.

Monitor the signal at Pin 12 of IC10. This signal should be a 5 V square wave with a period of 320 ms and a duty cycle ratio of 50/50.

Monitor the signal at Pin 13 of IC3. This signal is a 5 V level which drops to 0 V for 80 ms every 320 ms.

Monitor the signal at Pin 4 of IC19. This signal should be a 5 V square wave at a frequency of 10 Hz and a duty cycle ratio of 40/60.

Monitor the signal at Pin 13 of IC19. This signal should be a 5 V square wave at a frequency of 2 Hz and a duty cycle ratio of 40/60.

5.3.3.3 1004 Hz Frequency Generator (41-200 Board)

Monitor the signal at Pin 4 of IC13. This signal should be a 5 V pulse whose duration is approximately 1.5 µs and occurs every 498 µs.

Monitor the signal at Pin 1 of IC14. This signal should be a 5 V square wave at a frequency of 1004 Hz with a duty cycle ratio of 50/50.

Monitor the signal at Pin 1 of IC15. This signal should be a 1004 Hz sine wave at a level of 0.0 dBm ±1.5 dB.

5.3.3.4 Frequency Generator (41-200 Board)

Any malfunction in the frequency generator can best be isolated by waveform tracing using the timing diagram in Figure 5-11. Set the controls for a generator output of 1000 Hz ±5 Hz at a level of 0.0 dBm ±0.5 dB.

Using the negative going edge of waveform C as a trigger, verify the correct operation of the generator by observing the correct waveforms at

the test points listed. If the correct waveform is not observed, the gate or counter associated with that waveform is most likely defective.

At frequencies other than 1000 Hz, the waveform shapes will be the same but the time base will be different.

5.3.3.5 100.4 Hz Step (41-200 Board)

Using an oscilloscope, observe the waveform at Pin 7 of IC25. This waveform should be a short pulse varying from approximately -8 V to +8 V at a 100.4 Hz rate. The duration of the pulse at the bottom of the waveform should be approximately 30 µs.

If this waveform is not present, than IC25 is most likely defective. If this waveform is present, then IC37 or Q6 is most likely defective.

5.3.3.6 Send Output Filters (41-200 Board)

Using an oscilloscope, observe the signal at Pin 1 of IC25. As the generator frequency is varied from 200 Hz to 20 kHz, this output should be a clean sine wave with a peak value of 1.1 V ±0.2 V. If this signal is not present or has wide variations in signal level as the frequency is varied, then IC25 is most likely defective. If this signal is present over a portion of the frequency range, then comparators IC28 and IC34 or switches IC35, IC36, and IC37 may be defective.

At a frequency of 300 Hz, Pin 1 of IC28 should be approximately +7.5 V and IC35 should be on. At a frequency of 1000 Hz, the voltage at Pin 1 of IC34 should be +7.5 V and IC36 should be switched on. At a frequency of 5000 Hz, Pin 7 of IC34 should be approximately +7.5 V and switch IC37 should be switched on.

5.3.3.7 Output Amplifier (41-200 Board)

Adjust the operating controls for an output of 1000 Hz with a 600 Ω impedance. Using an ac voltmeter, monitor the signal at Pin 6 of IC38. As the level control is varied over its full range, this signal should vary over the range of at least -43.5 dB to +6.5 dB. If the signal does not vary at least over this range, then IC38 is most likely defective.

Monitor the signal at Pin 6 of IC40. This signal should vary over the range of at least -37.5 dB to +12.5 dB. If the signal does not vary over at least this range, then IC40 is most likely defective.

5.3.3.8 Frequency Counter (41-200 Board)

Set the controls to monitor the send frequency and adjust the send frequency to 1000 Hz. Monitor the signal at Pin 6 of IC16. This signal should be a square wave at the send frequency.

Monitor the signal at Pin 10 of IC17. With the 1 HZ resolution button pushed in, it should be a pulse at twice the input frequency rate. With the 10 HZ resolution button pushed in, it should be a pulse at the input frequency rate.

Monitor the signal at Pin 4 of IC18. With the 1 HZ resolution button pushed in, it should be a 2 Hz square wave. With the 10 HZ resolution button pushed in, it should be a 10 Hz square wave.

Monitor the signal at Pin 4 of IC24. This signal should be the same as the frequency at Pin 10 of IC17 which is gated on and off by the signal at Pin 13 of IC20. The signal at Pin 2 and Pin 3 of IC24 should be short negative pulses with a pulse duration of approximately 2 μs.

With the 1 HZ resolution button pushed in, apply an input signal greater than 10 kHz. Pin 6 of IC24 should then go negative and Pin 12 of IC21 should go positive enabling the blinking signal on Pin 2 of IC19. Under these conditions, the display should blink on and off. This blinking signal is coupled from Pin 11 of IC21 through D6 to the 41-400 board and then back to Pin 6 of IC23 of the 41-200 board.

If any one digit is not illuminated, then either the LED display or its digit driver is defective. The digit drivers are controlled by IC24 Pins 20 through 23. Under normal operation, each one of these pins is high for 25% of the time. If any segment on any one display is defective, then that display is most likely defective. If a segment is defective on all of the displays, then the segment driver is most likely defective. The segment drivers are controlled by IC24 Pins 13 through 19.

5.3.3.9 Audio Monitor (41-400 Board)

The audio monitor amplifier consists of IC1, Q1, and Q2 on the 41-400 board. Monitor the signal at Pin 3 of IC1. If no signal is present, then IC9 or IC1 on the 41-100 board is most likely defective. If the signal is present, monitor the signal at the emitter of either Q1 and Q2. This signal should be an amplifier version of the signal at Pin 3 of IC1. Some crossover distortion at this point is normal. If the signal is not present, then either

IC1, Q1, or Q2 is defective. If the signal is present but no sound is heard, then the speaker is most likely defective.

5.3.3.10 Receive Input Amplifier

Apply an input signal of 0.0 dBm at a freqeuncy of 1 kHz. Monitor the signal at Pin 6 of IC1. This signal should be a 1 kHz sine wave at a level of approximately 0.0 dBm. If this signal is not present, then the input termination or blocking capacitors are most likely defective.

Monitor the signal at Pin 7 of IC9. This signal should be a 1 kHz sine wave at a level of 0.0 dBm ±0.5 dB. If this signal is not present, verify that the signal is present at the input at Pin 12 of FC1. If the signal is present at the input, but not at Pin 7 of IC9, then either IC9 is defective or the send/receive switches Q1 through Q3 are defective.

Switching the 600 and 900 Ω terminations should cause a gain change of 1.5 dB ±0.2 dB at Pin 7 of IC9. If this gain change does not occur properly, then Q4 is most likely defective.

5.3.3.11 3 kHz Filter (41-100 Board)

With the NOTCH pushbutton out the 3 KHZ pushbutton in, monitor the signal at FC1 Pin 1. Apply an input signal of 1000 Hz at a level of 0.0 dBm. This signal should be present at Pin 1 of FC1. If the signal is not present, then IC1 on the 41-100 board is most likely defective. If the signal is present, monitor the signal at Pin 7 of IC1 on the 41-400 board. If the signal is not present, then either IC1 or switch S7 is defective.

5.3.3.12 C-Message Filter (41-100 Board)

With an input frequency of 1000 Hz at a level of 0.0 dBm, verify the presence of a signal at Pin 7 of IC1 on the 41-400 board as described in Section 5.3.3.11. If this signal is present, observe the signal at Pin 7 of IC2, Pin 1 of IC3, Pin 7 of IC3, Pin 7 of IC4 and Pin 1 of IC4. The 1 kHz signal should be present at each one of these points with a slight variation in level. If the signal is present at one point but not at the next point, then that IC is most likely defective.

5.3.3.13 Notch Filter (41-100 Board)

Depress both the NOTCH filter and the 3 KHZ filter pushbuttons. Apply an input signal of 1000 Hz at a level of 0.0 dBm. Monitor the signal at Pin 7 of IC1 on the 41-400 board. Verify that the signal is present when the NOTCH pushbutton is out but is not present when the NOTCH pushbutton is in. With the NOTCH pushbutton in, the level at Pin 7 of IC1 should drop at least 50 dB provided the total harmonic distortion of the input signal is less than 56 dBm.

If the correct signals are not present at Pin 7 of IC1, perform the notch filter calibration alignment as described in Section 5.3.4.5 of this manual. If any one section of the notch filter does not align properly, then that section of the filter is most likely defective.

5.3.3.14 Autorange Amplifier (41-100 Board)

Set the controls to monitor receive level and apply an input signal at a frequency of 1000 Hz at a level of 0.0 dBm. Monitor this signal at Pin 7 of IC14. This signal should be the 1000 Hz sine wave at a level of 0.0 dBm ±0.5 dB. If this signal is not present, then IC14 or Q13 may be defective.

Decrease the input level to -20.0 dBm. The level at Pin 7 of IC14 and Pin 7 of IC10 should be 0.0 dBm ±0.5 dB. If this signal is not present, then IC10 or Q12 may be defective.

Decrease the input level to -40.0 dBm. Monitor the signal at Pin 7 of IC14 and Pin 7 of IC11. This signal should be at a level of 0.0 dBm ±0.5 dB. If the signal is present at IC14 but not IC11, then Q11 is most likely defective.

Decrease the input level to -60.0 dBm. Monitor the signal at Pin 7 of IC14 and Pin 7 of IC15. This signal should be at a level of 0.0 dBm ±0.5 dB. If the signal is not present at IC14 but is present at IC15, then Q15 is most likely defective. If the signal is not present at IC15, then IC15 is most likely defective.

5.3.3.15 Detectors (41-100 Board)

Apply an input signal of 1000 Hz at a level of 0.0 dBm. Monitor the signal at the emitter of Q15 and Q17. In each case the signal should be a 1000 Hz sine wave at a level of 0.0 dBm ±0.5 dB. The level at both points should be the same but with opposite phase. If the signal is not present at the emitter of Q15, then either Q14, Q15, or IC14 is defective. If the correct signal is not present at the emitter of Q17, then Q16, Q17, or IC12 is defective.

Monitor the signal at Pin 7 of IC12. This should be a dc voltage of approximately +2 V. If the signal is not present, then IC12 is most likely defective.

5.3.3.16 Log Converter (41-200 Board)

Apply an input signal of 1000 Hz at a level of 0.0 dBm. Using Figure 5-2, monitor the waveform at the test point indicated. If the correct waveform is not present at a particular test point, then the IC pertaining to that test point is most likely defective.

5.3.3.17 Digital Voltmeter Controls (41-100 Board)

Set the controls to monitor receive level. Apply an input signal of 1000 Hz at a level of 0.0 dBm. Monitor the signal at the collectors of Q5 and Q6. A high signal corresponds to a voltage of +5 V. A low signal corresponds to a level of 0 V.

With an input of 0.0 dBm, both Q5 and Q6 should be low.

With a level of -20.0 dBm, Q5 should be high and Q6 should be low.

With an input level of -40.0 dBm, Q5 should be low and Q6 should be high.

With an input level of -60.0 dBm, both Q5 and Q6 should be high.

With an input signal of 0.0 dBm, Pin 12 of IC25 should be high and Pins 3, 4, and 13 should be low.

With an input level of -20.0 dBm, Pin 13 of IC25 should be high and Pins 3, 4, and 12 should be low.

With an input level of -40.0 dBm, Pins 12 and 13 of IC25 should be high and Pins 3 and 4 should be low.

With an input level of -60.0 dBm, Pin 3 of IC25 should be high and Pins 4, 12, and 13 should be low.

5.3.3.18 Digital Voltmeter Segment Drivers (41-100 Board)

Set the controls to monitor receive level. Apply an input signal of 1000 Hz at a level of 0.0 dBm.

The information from the counters IC25 through IC28 is coupled to the segment drivers IC29 through IC31 in a BCD code format. If the correct segments are not illuminated, verify that the correct code is present but the correct segment is not illuminated, then the segment is most likely defective. If the correct code is not present, then the counter corresponding to that segment driver is most likely defective.

5.3.4 Calibration

The following procedures are used to recalibrate the generator and receiver circuitry. Recalibration is normally required when maintenance has been performed on associated circuitry or when there is a reason to suspect that calibration is no longer accurate.

The local system ground used in the Model 41-01 is not at the same potential as chassis or earth ground. For this reason, floating test equipment should be used when making the following adjustments. When floating test equipment is not available, the unit must be operated on the ac line supply, and the black wire connected to the + terminal on the 41-200 board must be disconnected. Connection to the local ground can be made at the junction of the negative terminals of C42 and C44 toward the rear of the 41-200 board.

5.3.4.1 Power Supply (41-200 Board)

Step 1. Connect a digital dc voltmeter from the positive end of capacitor C44 and the negative end of capacitor C46.

Step 2. Adjust resistor R152 for a reading of 18.0 V dc ±0.5 V dc on the voltmeter.

Step 3. Connect the digital dc voltmeter across capacitor C42.

Step 4. Adjust resistor R160 for a reading of 5.00 V dc ±0.02 V dc.

5.3.4.2 Low Frequency Set (41-200 Board)

Step 1. Set the generator to the continuous mode.

Step 2. Monitor the output signal at the output terminal using an ac voltmeter and frequency counter.

Step 3. Set the level control for an output of -10.0 dBm ±0.02 dBm.

Step 4. Set the frequency control on the Model 41-01 to the fully counterclockwise position.

Step 5. Adjust resistor R69 for an output frequency of 175 Hz ±2 Hz. R69 may be adjusted through the access hole in the 41-100 board.

5.3.4.3 Signal Purity Adjustment (41-200 Board)

Step 1. Set the frequency control on the Model 41-01 for an output of 1010 Hz ±10 Hz.

Step 2. Set the send level to 0.0 dBm ±0.2 dBm.

Step 3. Connect the Model 41-01 send output to a 1010 Hz notch filter. Monitor the notch filter output on an ac voltmeter.

Step 4. Adjust R85 and R92, in turn, for a minimum reading on the ac voltmeter. R85 and R92 may be adjusted through the access hole in the 41-400 board.

5.3.4.4 1004 Hz Bandpass Filters (41-200 Board)

Step 1. Using an ac voltmeter, monitor the signal at Pin 7 of IC15.

Step 2. Using a short clip lead, ground the junction of capacitors C16 and C17 near FC4.

Step 3. Adjust R48 for a maximum signal reading on the voltmeter (≃ +6 dB).

Step 4. Remove the clip lead from the junction of C16 and C17.

Step 5. Adjust R52 for a minimum signal reading on the voltmeter (≃ -2 dB).

5.3.4.5 Notch Filter Alignment (41-100 Board)

Step 1. Set the Model 41-01 to the 3 KHZ plus NOTCH measurement mode.

Step 2. Set the receiver input to 600 Ω terminated.

Step 3. Apply an input frequency of 1010 Hz ±1 Hz at a level of 0.0 dBm ±0.2 dBm to the Model 41-01 input.

Step 4. Monitor the notch filter output at Pin 7 of IC8 using an ac voltmeter.

Step 5. Using short clip leads, place jumper wires across capacitors C17, C20, and C23.

Step 6. Adjust R55 and R59, in turn, for a null on the ac voltmeter.

Step 7. Remove the jumper wire from C23 and connect it across C26.

Step 8. Adjust R44 and R49 for a null on the ac voltmeter.

Step 9. Remove the jumper wire from C20 and connect it across C23.

Step 10. Adjust R35 and R40 for a null on the ac voltmeter.

Step 11. Remove the jumper wire from C17 and connect it across C20.

Step 12. Adjust R23 and R28 for a null on the ac voltmeter.

Step 13. Remove the jumper wires across C20, C23, and C26.

5.3.4.6 C-Message Filter Alignment (41-400 Board)

Step 1. Set the Model 41-01 to the C-MSG without NOTCH measurement mode.

Step 2. Apply an input signal of 2 kHz ±5 Hz at a level of -10.0 dBm to the input terminals.

Step 3. Monitor the signal at Pin 1 of IC4 using an ac voltmeter.

Step 4. Change the input frequency to 1 kHz ±5 Hz and adjust R4 for a reading 1.3 dBm ±0.2 dB above the value in Step 3.

Step 5. Repeat Steps 3 and 4 until no futher adjustment is required.

5.3.4.7 600 Ω Calibration (41-100 Board)

Step 1. Set the Model 41-01 to the receiver level measurement mode.

Step 2. Set the receiver input to 600 Ω terminated.

Step 3. Apply an input frequency of 1004 Hz ±5 Hz at a level of 0.0 dBm ±0.05 dB referenced to 600 Ω.

Step 4. Monitor the signal at Pin 7 of IC14 using the ac voltmeter.

Step 5. Adjust R71 for a reading of 0.00 dBm ±0.05 dB on the ac voltmeter.

5.3.4.8 900 Ω Calibration (41-100 Board)

Step 1. Set the Model 41-01 to the receiver level measurement mode.

Step 2. Set the receiver input to 900 Ω terminated.

Step 3. Apply an input signal of 1004 Hz ±5 Hz at a level of 0.0 dBm ±0.05 dB referenced to 900 Ω.

Step 4. Monitor the signal at Pin 7 of IC14 using the ac voltmeter.

Step 5. Adjust R69 for a reading of 0.00 dBm ±0.05 dB on the ac voltmeter.

5.3.4.9 Send Level Calibration (41-200 Board)

Step 1. Set the Model 41-01 to the send level measurement mode with 600 Ω output impedance.

Step 2. Connect a 600.0 Ω ±0.6 Ω terminating resistor to the Model 41-01 output terminals.

Step 3. Monitor the output across the 600 Ω terminating resistor using a digital ac voltmeter.

Step 4. Using the 100.4 Hz step mode, adjust the send signal for a frequency of 1004 Hz at a level of 0.7746 V ac ±0.002 V ac as measured with the digital ac voltmeter across the 600 Ω terminating resistor.

Step 5. Monitor the signal at Pin 7 of IC14 on the 41-100 board using an ac voltmeter.

Step 6. Adjust R81 to give a reading of 0.00 dBm ±0.05 dB on the ac voltmeter at Pin 7 of IC14.

Step 7. Set the Model 41-01 output to the fixed 1004 Hz mode.

Step 8. Adjust R53 for an output of 0.7746 V ac ±0.002 V ac as measured on the digital ac voltmeter.

5.3.4.10 Noise Calibration (41-100 Board)

Step 1. Set the Model 41-01 to the 3 KHZ without NOTCH measurement mode.

Step 2. Set the receiver input to 600 Ω terminated.

Step 3. Apply an input signal of 1000 Hz ±5 Hz at a level of 0.00 dBm ±0.05 dB on the ac voltmeter.

Step 4. Monitor the signal at Pin 7 of IC14 using an ac voltmeter.

Step 5. Adjust R4 on the 41-400 board for a reading of 0.00 dBm ±0.05 dB on the ac voltmeter.

Step 6. Set the Model 41-01 to the C-MSG without NOTCH measurement mode.

Step 7. Adjust R60 on the 41-100 board for a reading of 0.00 dBm ±0.05 dB on the ac voltmeter.

Step 8. Change the input frequency to 300 Hz ±5 Hz at a level of 0.00 dBm ±0.05 dB.

Step 9. Set the Model 41-01 to the 3 KHZ plus NOTCH measurement mode.

Step 10. Adjut R19 on the 41-100 board for a reading of 0.00 dBm ±0.05 dB.

5.3.4.11 Level Detecting Calibration (41-100 Board)

Step 1. Set the Model 41-01 to the receive level measurement mode.

Step 2. Set the receive input to 600 Ω terminated.

Step 3. Monitor the dc voltage of Pin 7 of IC12 using a digital dc voltmeter.

Step 4. Set the input signal to a frequency of 1000 Hz ±5 Hz at a level below -12.0 dBm and then increase to -10.0 dBm ±0.05 dB.

Step 5. Adjust R126 for a reading of 6.000 V dc ±0.006 V dc on the dc voltmeter.

Step 6. Set the input level above -8.0 dBm and then decrease to -10.00 dBm ±0.05 dB.

Step 7. Adjust R129 for a reading of 0.6000 V dc ±0.002 V dc on the dc voltmeter.

Step 8. Repeat Steps 4 through 7 until no further adjustment is required.

5.3.4.12 Log Converter Calibration (41-200 Board)

Step 1. Set the Model 41-01 to the receive level measurement mode.

Step 2. Set the receiver input to 600 Ω terminated.

Step 3. Set the input signal to 1000 Hz ±5 Hz to a level of less than -12.0 dBm and then increase to -10.00 dBm ±0.05 dB.

Step 4. Adjust R10 for a reading of -10.0 dBm on the Model 41-01.

Step 5. Set the input signal level to greater than -8.0 dBm and then decrease to -10.00 dBm ±0.05 dB.

Step 6. Adjust R15 for a reading of -10.0 dBm on the Model 41-01.

Step 7. Repeat Steps 3 through 6 unitl no further adjustment is required.

5.3.4.13 Noise Detector Calibration (41-100 Board)

Step 1. Monitor the dc voltage at Pin 7 of IC13.

Step 2. Using a short clip lead, ground the positive end of capacitor C38.

Step 3. Adjust R135 for a reading of 0.000 V dc ±0.005 V dc on the dc voltmeter.

Step 4. Remove the clip lead from the positive ends of C38.

Step 5. Set the Model 41-01 to the receive level measurement mode.

Step 6. Set the input signal to 1000 Hz ±5 Hz at a level of -10.5 dBm as read on the Model 41-01.

Step 7. Set the Model 41-01 to 3.0 KHZ without NOTCH measurement mode.

Step 8. Adjust R4 on the 41-400 board so that the Model 41-01 meter reading just switches between +79 and +80 dBrn.

DOC #: ** MODEL ASSEMBLY INDEX ** DATE: 5/12/81

MODEL: 41-01 NAME: TRANSMISSION TEST SET

ASSEMBLY NO.	DESCRIPTION	PAGE
D41-01-0	MECHANICAL ASSY	5-20
D41-01-0-1	CHASSIS SUB ASSY	5-21
D41-01-0-2	HEAT SINK SUB ASSY	5-22
D41-01-1	RECEIVER PC BD ASSY (102)	5-23
D41-01-2	GENERATOR PC BD ASSY (202)	5-30
D41-01-3	DISPLAY PC BD ASSY (302)	5-36
D41-01-4	SWITCH PC BD ASSY (402)	5-37
	------ END OF FILE -----	

DOC NO: **PARTS LIST BY ASSEMBLY** DATE: 5/12/81
ASSEMBLY NO: D41-01-0
DESCRIPTION: MECHANICAL ASSY

REF DES./QTY	STOCK NO.	DESCRIPTION
2	23A00002	SPACER SPLIT ROLLED 4 X 1/4 STD-AK
2	23A00005	SPACER SPLIT 4 X 3/4 STD-AK
2	23A00011	SPACER 1/4 OD X 1/4 #6 PHENOLIC
2	23D00030	CLAMP CABLE
2	24A04003C	SCREW 4-40 X 3/16 FH-SL-SNP
11	24A04004A	SCREW 4-40 X 1/4 BH-SL-SNP
2	24A04008A	SCREW 4-40 X 1/2 BH-SL-SNP
2	24A04016A	SCREW 4-40 X 1 BH-SL-SNP
17	24A04101	WASHER FLAT #4 MS15795-803
16	24A04104	WASHER EXT TOOTH #4
1	24A04204	NUT HEX 4 - 40 SNP
8	24A06004A	SCREW 6-32 X 1/4 BH-SL-SNP
4	24A06005A	SCREW 6-32 X 5/16 BH-SL-SNP
2	24A06010A	SCREW 6-32 X 5/8 BH-SL-SNP
3	24Z00013	WASHER FIBER 2161
2	F41-3A	A RACK MOUNTING BRACKET
1	F41-5-1	A HOLDER, P.C. BD
1	F41-5-2	A HOLDER, P.C. BD
1	F41-2E	COVER
SUB	D41-01-0-1	CHASSIS SUB ASSY
SUB	D41-01-0-2	HEAT SINK SUB ASSY
REF	D41D	
		------ END OF FILE -----

DOC NO: **PARTS LIST BY ASSEMBLY** DATE: 5/12/81
ASSEMBLY NO: D41-01-0-1
DESCRIPTION: CHASSIS SUB ASSY

REF DES./QTY	STOCK NO.	DESCRIPTION
C1	01A11000A1	CAP CER .01uF GMV 1.6KV
C2	01A11000A1	CAP CER .01uF GMV 1.6KV
R2	13B11000A	RES CARBON 10K 10% .5W 1 TURN
R3	13B12000	RES WIREWOUND 20K 5% 2W 10 TURN
R4	13B12000	RES WIREWOUND 20K 5% 2W 10 TURN
1	16B00040	TRANSFORMER POWER
1	17B00001	TRANSDUCER 48 OHM
4	19C00004	CONN BINDING POST RED
2	19D00003	CONN PHONE 3 CONTACT
2	19E00007	CONN MOLEX TERMINAL
1	19E00008	CONN MOLEX 2 CONTACT
1	19M00005	CONN POWER CORD
1	19P00003	CONN BARRIER STRIP 8 CONTACT
1	19Q00003	CONN HAY RAKE 3 CONTACT
1	23C00005	KNOB 1/8
2	23C00013	KNOB 1/4 BLACK
1	23D00040	HOLDER FUSE
1	23D00041	CLIP ALLEN WRENCH
3	24A04003C	SCREW 4-40 X 3/16 FH-SL-SNP
2	24A04004A	SCREW 4-40 X 1/4 BH-SL-SNP
4	24A04007A	SCREW 4-40 X 7/16 BH-SL-SNP
2	24A04102	WASHER FLAT #4 SCP
9	24A04104	WASHER EXT TOOTH #4
9	24A04204	NUT HEX 4 - 40 SNP
1	24Z00025	LUG SOLDER 1416-4
1	26A00001	FUSE 1 AMP SB
2	26D00001	COMMUNICATIONS GAP
1	F41-23	A DISPLAY WINDOW
1	F41-28	A LABEL
1	F41-30	A LABEL
1	F41-32	A LABEL
1	F41-6	A XFMR HOLDER, POWER BRACKET
1	F41-077A	HARNESS LAYOUT "A" MODEL 41
1	F41-079	HARNESS LAYOUT "B" MODEL 41
1	F41-081	HARNESS LAYOUT "C" MODEL 41
1	F41-110	CHASSIS-01 & 48V OPTION
REF	A41-076A	
REF	A41-078	
REF	A41-080	
REF	A41-082	
REF	D41-24	
		------ END OF FILE -----

DOC NO: **PARTS LIST BY ASSEMBLY** DATE: 5/12/81
ASSEMBLY NO: D41-01-0-2
DESCRIPTION: HEAT SINK SUB ASSY

REF DES./QTY	STOCK NO.	DESCRIPTION
Q21	05B00004	TRANSISTOR PNP MJE2955
Q22	05D00003	TRANSISTOR NPN MJE1100
Q23	05B00002	TRANSISTOR PNP MJE1090
Q24	05D00004	TRANSISTOR NPN MJE3055
4	23J00005	INSULATOR MICA ROUND 6/32
4	24A06010A	SCREW 6-32 X 5/8 BH-SL-SNP
4	24A06104	WASHER EXT TOOTH #6
4	24A06204	NUT HEX 6 - 32 X 5/16 SNP
4	24Z00021	WASHER COMPRESSION
1	F41-4-1A	HEAT SINK
1	F41-4-2A	HEAT SINK
		------ END OF FILE -----

DOC NO: **PARTS LIST BY ASSEMBLY** DATE: 5/12/81
ASSEMBLY NO: D41-01-1
DESCRIPTION: RECEIVER PC BD ASSY (102)

REF DES./QTY	STOCK NO.	DESCRIPTION
C1	01D11000	CAP POLYSTY .01uF 1% 33V
C2	01D11000	CAP POLYSTY .01uF 1% 33V
C3	01D21000	CAP POLYSTY .1uF 1% 33V
C4	01D21000	CAP POLYSTY .1uF 1% 33V
C5	01D11300	CAP POLYSTY .013uF 1% 33V
C6	01D04700	CAP POLYSTY 4700PF 1% 33V
C7	01D11300	CAP POLYSTY .013uF 1% 33V
C8	01E24700	CAP POLYCARB .47uF 5% 100V
C9	01D03900	CAP POLYSTY 3900PF 1% 33V
C10	01D11000	CAP POLYSTY .01uF 1% 33V
C11	01D12700	CAP POLYSTY .027uF 1% 33V
C12	01D11000	CAP POLYSTY .01uF 1% 33V
C13	01D00220	CAP POLYSTY 220PF 1% 160V
C14	01D05000A	CAP POLYSTY 5000PF 2.5% 33V
C16	01D11000	CAP POLYSTY .01uF 1% 33V
C17	01D11000	CAP POLYSTY .01uF 1% 33V
C18	01B00047C	CAP MICA 47PF 5% 500V
C19	01D11000	CAP POLYSTY .01uF 1% 33V
C20	01D11000	CAP POLYSTY .01uF 1% 33V
C21	01B00082C	CAP MICA 82PF 5% 500V
C22	01D11000	CAP POLYSTY .01uF 1% 33V
C23	01D11000	CAP POLYSTY .01uF 1% 33V
C24	01B00430C	CAP MICA 430PF 5% 500V
C25	01D11000	CAP POLYSTY .01uF 1% 33V
C26	01D11000	CAP POLYSTY .01uF 1% 33V
C27	01G32200	CAP TANT ELEC 2.2uF 10% 20V
C28	01G32200	CAP TANT ELEC 2.2uF 10% 20V
C29	01G32200	CAP TANT ELEC 2.2uF 10% 20V
C30	01G32200	CAP TANT ELEC 2.2uF 10% 20V
C31	01G32200	CAP TANT ELEC 2.2uF 10% 20V
C32	01G42200	CAP TANT ELEC 22uF 10% 15V
C33	01G32200	CAP TANT ELEC 2.2uF 10% 20V
C34	01G32200	CAP TANT ELEC 2.2uF 10% 20V
C35	01G32200	CAP TANT ELEC 2.2uF 10% 20V
C36	01G32200	CAP TANT ELEC 2.2uF 10% 20V
C37	01G42200	CAP TANT ELEC 22uF 10% 15V
C38	01G42200	CAP TANT ELEC 22uF 10% 15V
C39	01G42200	CAP TANT ELEC 22uF 10% 15V
C40	01E22200A	CAP POLYCARB .22uF 5% 100V
C41	01D00560	CAP POLYSTY 560PF 1% 33V
C42	01G32200	CAP TANT ELEC 2.2uF 10% 20V
C43	01A11000	CAP CER .01uF 20% 50V
C44	01A11000	CAP CER .01uF 20% 50V
C45	01D11000	CAP POLYSTY .01uF 1% 33V
C46	01A00010	CAP CER 10PF 0.5PF 1KV
C47	01A00010	CAP CER 10PF 0.5PF 1KV
C48	01A00020	CAP CER 20PF 5% 1KV
C49	01A11000	CAP CER .01uF 20% 50V
C50	01A11000	CAP CER .01uF 20% 50V
C51	01A11000	CAP CER .01uF 20% 50V
C52	01A11000	CAP CER .01uF 20% 50V
C53	01A11000	CAP CER .01uF 20% 50V
C54	01A11000	CAP CER .01uF 20% 50V
C55	01A11000	CAP CER .01uF 20% 50V

REF DES./QTY	STOCK NO.	DESCRIPTION
C56	01A11000	CAP CER .01uF 20% 50V
C57	01A11000	CAP CER .01uF 20% 50V
C58	01A11000	CAP CER .01uF 20% 50V
C59	01A11000	CAP CER .01uF 20% 50V
C60	01A11000	CAP CER .01uF 20% 50V
C61	01A11000	CAP CER .01uF 20% 50V
C62	01A11000	CAP CER .01uF 20% 50V
C63	01A11000	CAP CER .01uF 20% 50V
C64	01A11000	CAP CER .01uF 20% 50V
C65	01A11000	CAP CER .01uF 20% 50V
C66	01A11000	CAP CER .01uF 20% 50V
C67	01A11000	CAP CER .01uF 20% 50V
C68	01A11000	CAP CER .01uF 20% 50V
C69	01A11000	CAP CER .01uF 20% 50V
C70	01A11000	CAP CER .01uF 20% 50V
C71	01A11000	CAP CER .01uF 20% 50V
C72	01A11000	CAP CER .01uF 20% 50V
C73	01A11000	CAP CER .01uF 20% 50V
C74	01A11000	CAP CER .01uF 20% 50V
C75	01A11000	CAP CER .01uF 20% 50V
C76	01A11000	CAP CER .01uF 20% 50V
C77	01A11000	CAP CER .01uF 20% 50V
C78	01A11000	CAP CER .01uF 20% 50V
C79	01A11000	CAP CER .01uF 20% 50V
C80	01A11000	CAP CER .01uF 20% 50V
C81	01A11000	CAP CER .01uF 20% 50V
C82	01B00130C	CAP MICA 130PF 5% 500V
D1	03A03064	DIODE SIGNAL 1N3064 75V
D3	03A03064	DIODE SIGNAL 1N3064 75V
D4	03A03064	DIODE SIGNAL 1N3064 75V
D5	03A03064	DIODE SIGNAL 1N3064 75V
D6	03A03064	DIODE SIGNAL 1N3064 75V
D7	03A03064	DIODE SIGNAL 1N3064 75V
D8	03A03064	DIODE SIGNAL 1N3064 75V
D9	03A03064	DIODE SIGNAL 1N3064 75V
D10	03A03064	DIODE SIGNAL 1N3064 75V
D11	03A03064	DIODE SIGNAL 1N3064 75V
D12	03A03064	DIODE SIGNAL 1N3064 75V
D13	03A03064	DIODE SIGNAL 1N3064 75V
D14	03A03064	DIODE SIGNAL 1N3064 75V
D15	03A03064	DIODE SIGNAL 1N3064 75V
D16	03A03064	DIODE SIGNAL 1N3064 75V
D17	03A03064	DIODE SIGNAL 1N3064 75V
D18	03A03064	DIODE SIGNAL 1N3064 75V
D19	03A03064	DIODE SIGNAL 1N3064 75V
D20	03A03064	DIODE SIGNAL 1N3064 75V
D21	03A03064	DIODE SIGNAL 1N3064 75V
D22	03A03064	DIODE SIGNAL 1N3064 75V
D23	03A03064	DIODE SIGNAL 1N3064 75V
D24	03A03064	DIODE SIGNAL 1N3064 75V
D25	03A03064	DIODE SIGNAL 1N3064 75V
D26	03A03064	DIODE SIGNAL 1N3064 75V
D27	03A03064	DIODE SIGNAL 1N3064 75V
D28	03A03064	DIODE SIGNAL 1N3064 75V

REF DES./QTY	STOCK NO.	DESCRIPTION
IC1	08A00356	IC OP AMP 356
IC2	08B04558	IC OP AMP 4558
IC3	08B04558	IC OP AMP 4558
IC4	08B04558	IC OP AMP 4558
IC5	08B04558	IC OP AMP 4558
IC6	08B04558	IC OP AMP 4558
IC7	08B04558	IC OP AMP 4558
IC8	08B04558	IC OP AMP 4558
IC9	08B04558	IC OP AMP 4558
IC10	08B04558	IC OP AMP 4558
IC11	08B04558	IC OP AMP 4558
IC12	08B04558	IC OP AMP 4558
IC13	08B04558	IC OP AMP 4558
IC14	08B04558	IC OP AMP 4558
IC15	08B04558	IC OP AMP 4558
IC16	08B04558	IC OP AMP 4558
IC17	07004069	IC CMOS 4069UB
IC18	07004023	IC CMOS 4023B
IC19	07004001	IC CMOS 4001B
IC20	07004013A	IC CMOS 4013B
IC21	07004070	IC CMOS 4070B
IC22	07004001	IC CMOS 4001B
IC23	07004013A	IC CMOS 4013B
IC24	07004011A	IC CMOS 4011B
IC25	07004510	IC CMOS 4510B
IC26	07004510	IC CMOS 4510B
IC27	07004510	IC CMOS 4510B
IC28	07004510	IC CMOS 4510B
IC29	07004511	IC CMOS 4511B
IC30	07004511	IC CMOS 4511B
IC31	07004511	IC CMOS 4511B
IC32	07004002	IC CMOS 4002B
IC33	07004011A	IC CMOS 4011B
IC34	07004013A	IC CMOS 4013B
IC35	07004011A	IC CMOS 4011B
IC36	07004069	IC CMOS 4069UB
Q1	05E05639	TRANSISTOR JFET 2N5639
Q2	05A04403	TRANSISTOR PNP 2N4403
Q3	05E05639	TRANSISTOR JFET 2N5639
Q4	05E05639	TRANSISTOR JFET 2N5639
Q5	05C04401	TRANSISTOR NPN 2N4401
Q6	05C04401	TRANSISTOR NPN 2N4401
Q7	05A04403	TRANSISTOR PNP 2N4403
Q8	05A04403	TRANSISTOR PNP 2N4403
Q9	05A04403	TRANSISTOR PNP 2N4403
Q10	05E05639	TRANSISTOR JFET 2N5639
Q11	05E05639	TRANSISTOR JFET 2N5639
Q12	05E05639	TRANSISTOR JFET 2N5639
Q13	05E05639	TRANSISTOR JFET 2N5639
Q14	05C04401	TRANSISTOR NPN 2N4401
Q15	05A04403	TRANSISTOR PNP 2N4403
Q16	05C04401	TRANSISTOR NPN 2N4401
Q17	05A04403	TRANSISTOR PNP 2N4403
Q21	05C04401	TRANSISTOR NPN 2N4401

REF DES./QTY	STOCK NO.	DESCRIPTION
Q22	05E05639	TRANSISTOR JFET 2N5639
Q23	05C04401	TRANSISTOR NPN 2N4401
Q24	05C04401	TRANSISTOR NPN 2N4401
R1	12F13920	RES METAL FILM 39.2K 1% 1/4W
R2	12F06040	RES METAL FILM 6.04K 1% 1/4W
R3	12FD3650	RES METAL FILM 365 OHM 1% 1/4W
R5	12F11000	RES METAL FILM 10.0K 1% 1/4W
R6	12FD2000	RES METAL FILM 200 OHM 1% 1/4W
R7	12F04990	RES METAL FILM 4.99K 1% 1/4W
R8	12F04990	RES METAL FILM 4.99K 1% 1/4W
R9	12F04990	RES METAL FILM 4.99K 1% 1/4W
R10	12F07870	RES METAL FILM 7.87K 1% 1/4W
R11	12F07870	RES METAL FILM 7.87K 1% 1/4W
R12	12F21000	RES METAL FILM 100K 1% 1/4W
R13	12F13240	RES METAL FILM 32.4K 1% 1/4W
R14	12F13240	RES METAL FILM 32.4K 1% 1/4W
R15	12F13240	RES METAL FILM 32.4K 1% 1/4W
R16	12F07500	RES METAL FILM 7.50K 1% 1/4W
R17	12F07500	RES METAL FILM 7.50K 1% 1/4W
R18	12B21000	RES CARBON 100K 5% 1/4W
R19	13A05000	RES METAL FILM 5K 10% .5W 1 TURN
R20	12F05490	RES METAL FILM 5.49K 1% 1/4W
R21	12F09530	RES METAL FILM 9.53K 1% 1/4W
R22	12F06340	RES METAL FILM 6.34K 1% 1/4W
R23	13AD5000	RES METAL FILM 500 OHM 10% .5W 1 TURN
R24	12F03090	RES METAL FILM 3.09K 1% 1/4W
R25	12F11580	RES METAL FILM 15.8K 1% 1/4W
R26	12F21180	RES METAL FILM 118K 1% 1/4W
R27	12F11470	RES METAL FILM 14.7K 1% 1/4W
R28	13A02000	RES METAL FILM 2K 10% .5W 1 TURN
R29	12F11150	RES METAL FILM 11.5K 1% 1/4W
R30	12F04870	RES METAL FILM 4.87K 1% 1/4W
R31	12F02870	RES METAL FILM 2.87K 1% 1/4W
R32	12F05110	RES METAL FILM 5.11K 1% 1/4W
R33	12F11370	RES METAL FILM 13.7K 1% 1/4W
R34	12F05360	RES METAL FILM 5.36K 1% 1/4W
R35	13A01000A2	RES METAL FILM 1K 10% .75W 15 TURN
R36	12F03650	RES METAL FILM 3.65K 1% 1/4W
R37	12F11580	RES METAL FILM 15.8K 1% 1/4W
R38	12F08660	RES METAL FILM 8.66K 1% 1/4W
R39	12F11470	RES METAL FILM 14.7K 1% 1/4W
R40	13A02000	RES METAL FILM 2K 10% .5W 1 TURN
R41	12F02150	RES METAL FILM 2.15K 1% 1/4W
R42	12F11130	RES METAL FILM 11.3K 1% 1/4W
R43	12F05360	RES METAL FILM 5.36K 1% 1/4W
R44	13A01000A2	RES METAL FILM 1K 10% .75W 15 TURN
R45	12F03650	RES METAL FILM 3.65K 1% 1/4W
R46	12F11580	RES METAL FILM 15.8K 1% 1/4W
R47	12F08660	RES METAL FILM 8.66K 1% 1/4W
R48	12F11470	RES METAL FILM 14.7K 1% 1/4W
R49	13A02000	RES METAL FILM 2K 10% .5W 1 TURN
R50	12F06810	RES METAL FILM 6.81K 1% 1/4W
R51	12F08450	RES METAL FILM 8.45K 1% 1/4W
R52	12F05760	RES METAL FILM 5.76K 1% 1/4W

REF DES./QTY	STOCK NO.	DESCRIPTION
R53	12F11580	RES METAL FILM 15.8K 1% 1/4W
R54	12F01370	RES METAL FILM 1.37K 1% 1/4W
R55	13A01000A2	RES METAL FILM 1K 10% .75W 15 TURN
R56	12F03240	RES METAL FILM 3.24K 1% 1/4W
R57	12F12430	RES METAL FILM 24.3K 1% 1/4W
R58	12F11470	RES METAL FILM 14.7K 1% 1/4W
R59	13A02000	RES METAL FILM 2K 10% .5W 1 TURN
R60	13A05000	RES METAL FILM 5K 10% .5W 1 TURN
R61	12F11000	RES METAL FILM 10.0K 1% 1/4W
R62	12F11000	RES METAL FILM 10.0K 1% 1/4W
R63	12B31000	RES CARBON 1.0M 5% 1/4W
R64	12B31000	RES CARBON 1.0M 5% 1/4W
R65	12B21000	RES CARBON 100K 5% 1/4W
R66	12B31000	RES CARBON 1.0M 5% 1/4W
R68	12F18870	RES METAL FILM 88.7K 1% 1/4W
R69	13A12000A	RES METAL FILM 20K 10% .5W 1 TURN
R70	12F11780	RES METAL FILM 17.8K 1% 1/4W
R71	13A02000A	RES METAL FILM 2K 10% .5W 1 TURN
R72	12J11000	RES METAL FILM 10.00K .1% 1/10W
R73	12J21000	RES METAL FILM 100.0K .1% 1/10W
R75	12F11000	RES METAL FILM 10.0K 1% 1/4W
R76	12F21000	RES METAL FILM 100K 1% 1/4W
R77	12J11000	RES METAL FILM 10.00K .1% 1/10W
R78	12J21000	RES METAL FILM 100.0K .1% 1/10W
R80	12F21000	RES METAL FILM 100K 1% 1/4W
R81	12F11000	RES METAL FILM 10.0K 1% 1/4W
R82	12J11000	RES METAL FILM 10.00K .1% 1/10W
R83	12J21000	RES METAL FILM 100.0K .1% 1/10W
R85	12F11000	RES METAL FILM 10.0K 1% 1/4W
R86	12F21000	RES METAL FILM 100K 1% 1/4W
R87	12J11000	RES METAL FILM 10.00K .1% 1/10W
R88	12J11000	RES METAL FILM 10.00K .1% 1/10W
R89	12J11000	RES METAL FILM 10.00K .1% 1/10W
R90	12J11000	RES METAL FILM 10.00K .1% 1/10W
R91	12B31000	RES CARBON 1.0M 5% 1/4W
R92	12B31000	RES CARBON 1.0M 5% 1/4W
R93	12B31000	RES CARBON 1.0M 5% 1/4W
R94	12B31000	RES CARBON 1.0M 5% 1/4W
R95	12F11000	RES METAL FILM 10.0K 1% 1/4W
R96	12B11000	RES CARBON 10K 5% 1/4W
R97	12F11000	RES METAL FILM 10.0K 1% 1/4W
R98	12F11000	RES METAL FILM 10.0K 1% 1/4W
R99	12F11000	RES METAL FILM 10.0K 1% 1/4W
R100	12F11000	RES METAL FILM 10.0K 1% 1/4W
R101	12F11780	RES METAL FILM 17.8K 1% 1/4W
R102	12F11000	RES METAL FILM 10.0K 1% 1/4W
R103	12B11000	RES CARBON 10K 5% 1/4W
R104	12B13000	RES CARBON 30K 5% 1/4W
R105	12B13000	RES CARBON 30K 5% 1/4W
R106	12B11000	RES CARBON 10K 5% 1/4W
R107	12B13000	RES CARBON 30K 5% 1/4W
R108	12B21000	RES CARBON 100K 5% 1/4W
R109	12F03830	RES METAL FILM 3.83K 1% 1/4W
R110	12F21000	RES METAL FILM 100K 1% 1/4W

DOC NO: **PARTS LIST BY ASSEMBLY** DATE: 5/12/81
ASSEMBLY NO: D41-01-1
DESCRIPTION: RECEIVER PC BD ASSY (102)

REF DES./QTY	STOCK NO.	DESCRIPTION
R111	12F21000	RES METAL FILM 100K 1% 1/4W
R112	12F03830	RES METAL FILM 3.83K 1% 1/4W
R113	12B12000	RES CARBON 20K 5% 1/4W
R114	12B21000	RES CARBON 100K 5% 1/4W
R115	12B21000	RES CARBON 100K 5% 1/4W
R116	12F21000	RES METAL FILM 100K 1% 1/4W
R117	12F03830	RES METAL FILM 3.83K 1% 1/4W
R118	12B12000	RES CARBON 20K 5% 1/4W
R119	12B21000	RES CARBON 100K 5% 1/4W
R120	12B21000	RES CARBON 100K 5% 1/4W
R121	12B12000	RES CARBON 20K 5% 1/4W
R122	12B21000	RES CARBON 100K 5% 1/4W
R123	12B21000	RES CARBON 100K 5% 1/4W
R124	12F21000	RES METAL FILM 100K 1% 1/4W
R125	12F22320	RES METAL FILM 232K 1% 1/4W
R126	13A15000	RES METAL FILM 50K 10% .5W 1 TURN
R127	12FD3010	RES METAL FILM 301 OHM 1% 1/4W
R128	12F21500	RES METAL FILM 150K 1% 1/4W
R129	13A21000A	RES METAL FILM 100K 10% .5W 1 TURN
R130	12F05110	RES METAL FILM 5.11K 1% 1/4W
R131	12F21000	RES METAL FILM 100K 1% 1/4W
R132	12F12000	RES METAL FILM 20.0K 1% 1/4W
R133	12F11240	RES METAL FILM 12.4K 1% 1/4W
R134	12F13010	RES METAL FILM 30.1K 1% 1/4W
R135	13A21000A	RES METAL FILM 100K 10% .5W 1 TURN
R136	12FD3010	RES METAL FILM 301 OHM 1% 1/4W
R137	12B31000	RES CARBON 1.0M 5% 1/4W
R138	12F11000	RES METAL FILM 10.0K 1% 1/4W
R139	12F07150	RES METAL FILM 7.15K 1% 1/4W
R140	12F21000	RES METAL FILM 100K 1% 1/4W
R141	12F11000	RES METAL FILM 10.0K 1% 1/4W
R142	12F13010	RES METAL FILM 30.1K 1% 1/4W
R143	12F21370	RES METAL FILM 137K 1% 1/4W
R144	12B11000	RES CARBON 10K 5% 1/4W
R145	12F13480	RES METAL FILM 34.8K 1% 1/4W
R146	12F21000	RES METAL FILM 100K 1% 1/4W
R147	12F01000	RES METAL FILM 1.00K 1% 1/4W
R148	12F25110	RES METAL FILM 511K 1% 1/4W
R149	12B11000	RES CARBON 10K 5% 1/4W
R150	12B11000	RES CARBON 10K 5% 1/4W
R151	12B11000	RES CARBON 10K 5% 1/4W
R152	12B15100	RES CARBON 51K 5% 1/4W
R155	12BD2700	RES CARBON 270 OHM 5% 1/4W
R156	12BD2700	RES CARBON 270 OHM 5% 1/4W
R157	12BD2700	RES CARBON 270 OHM 5% 1/4W
R158	12BD2700	RES CARBON 270 OHM 5% 1/4W
R159	12BD2700	RES CARBON 270 OHM 5% 1/4W
R160	12BD2700	RES CARBON 270 OHM 5% 1/4W
R161	12BD2700	RES CARBON 270 OHM 5% 1/4W
R162	12BD2700	RES CARBON 270 OHM 5% 1/4W
R163	12BD2700	RES CARBON 270 OHM 5% 1/4W
R164	12BD2700	RES CARBON 270 OHM 5% 1/4W
R165	12BD2700	RES CARBON 270 OHM 5% 1/4W
R166	12BD2700	RES CARBON 270 OHM 5% 1/4W

DOC NO: **PARTS LIST BY ASSEMBLY** DATE: 5/12/81
ASSEMBLY NO: D41-01-1
DESCRIPTION: RECEIVER PC BD ASSY (102)

REF DES./QTY	STOCK NO.	DESCRIPTION
R167	12BD2700	RES CARBON 270 OHM 5% 1/4W
R168	12BD2700	RES CARBON 270 OHM 5% 1/4W
R169	12BD2700	RES CARBON 270 OHM 5% 1/4W
R170	12BD2700	RES CARBON 270 OHM 5% 1/4W
R171	12BD2700	RES CARBON 270 OHM 5% 1/4W
R172	12BD2700	RES CARBON 270 OHM 5% 1/4W
R173	12BD2700	RES CARBON 270 OHM 5% 1/4W
R174	12BD2700	RES CARBON 270 OHM 5% 1/4W
R175	12BD2700	RES CARBON 270 OHM 5% 1/4W
R176	12B21000	RES CARBON 100K 5% 1/4W
R177	12BD1000	RES CARBON 100 OHM 5% 1/4W
R178	12BC1000	RES CARBON 10 OHM 5% 1/4W
R179	12B21000	RES CARBON 100K 5% 1/4W
R180	12B21000	RES CARBON 100K 5% 1/4W
R181	12B21000	RES CARBON 100K 5% 1/4W
R182	12B31000	RES CARBON 1.0M 5% 1/4W
R183	12F11370	RES METAL FILM 13.7K 1% 1/4W
R184	12B21000	RES CARBON 100K 5% 1/4W
R185	12B12000	RES CARBON 20K 5% 1/4W
R186	12B11000	RES CARBON 10K 5% 1/4W
R187	12BD2700	RES CARBON 270 OHM 5% 1/4W
R188	12BD1300	RES CARBON 130 OHM 5% 1/4W
R189	12F12000	RES METAL FILM 20.0K 1% 1/4W
R190	12F12000	RES METAL FILM 20.0K 1% 1/4W
R191	12F11210	RES METAL FILM 12.1K 1% 1/4W
R192	12B11000	RES CARBON 10K 5% 1/4W
T1	16A00022	TRANSFORMER SIGNAL 10K:10K .04-20KHZ
3	19B00002	CONN FERRULE
1	19L00023	CONN 6 CONTACT
2	19L00034	CONN 18 CONTACT
4	19R00004	CONN TERMINAL
1	23H00003	STEEL CAN
2	F-HLI-050	B CAPACITOR SPACER
1	F41-085	B CABLE "A" MODEL 41
1	F41-086	B CABLE "B" MODEL 41
1	F41-102E-1	C PC D&T 100 & 200 BD
REF	D41-103B-1	COMPONENT LAYOUT
REF	D41-104-01F-3	SCHEMATIC DIAGRAM
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DOC NO: **PARTS LIST BY ASSEMBLY** DATE: 5/12/81
ASSEMBLY NO: D41-01-2
DESCRIPTION: GENERATOR PC BD ASSY (202)

REF DES./QTY	STOCK NO.	DESCRIPTION
C1	01A21000A	CAP CER .1uF 20% 20V
C2	01D14700	CAP POLYSTY .047uF 1% 33V
C4	01B00033C	CAP MICA 33PF 5% 500V
C5	01B00110C	CAP MICA 110PF 5% 500V
C6	02A00001	CAP CER 5.5-18PF
C7	01B00390C	CAP MICA 390PF 5% 500V
C8	01B00390C	CAP MICA 390PF 5% 500V
C9	01A00047	CAP CER 47PF 20% 1KV
C10	01A00047	CAP CER 47PF 20% 1KV
C11	01A00047	CAP CER 47PF 20% 1KV
C12	01A11000	CAP CER .01uF 20% 50V
C13	01D01000	CAP POLYSTY 1000PF 1% 33V
C14	01D11000	CAP POLYSTY .01uF 1% 33V
C15	01D11000	CAP POLYSTY .01uF 1% 33V
C16	01D11000	CAP POLYSTY .01uF 1% 33V
C17	01D11000	CAP POLYSTY .01uF 1% 33V
C18	01B00068C	CAP MICA 68PF 5% 500V
C19	01B00018C	CAP MICA 18PF 5% 500V
C20	01E24700	CAP POLYCARB .47uF 5% 100V
C21	01D12200	CAP POLYSTY .022uF 1% 33V
C22	01E21000	CAP POLYCARB .1uF 5% 250V
C23	01D11000	CAP POLYSTY .01uF 1% 33V
C24	01B00100C1	CAP MICA 100PF 5% 500V
C25	01B00680C	CAP MICA 680PF 5% 300V
C26	01D04700	CAP POLYSTY 4700PF 1% 33V
C27	01D11200	CAP POLYSTY .012uF 1% 33V
C28	01B00690C	CAP MICA 690PF 5% 300V
C29	01A00047	CAP CER 47PF 20% 1KV
C31	01A11000	CAP CER .01uF 20% 50V
C32	01E24700	CAP POLYCARB .47uF 5% 100V
C33	01A11000	CAP CER .01uF 20% 50V
C34	01A11000	CAP CER .01uF 20% 50V
C35	01042200	CAP TANT ELEC 22uF 10% 15V
C36	01042200	CAP TANT ELEC 22uF 10% 15V
C37	01A21000A	CAP CER .1uF 20% 20V
C38	01H62100	CAP AL ELEC 2100uF -10 +75% 40V
C39	01032200	CAP TANT ELEC 2.2uF 10% 20V
C40	01A11000	CAP CER .01uF 20% 50V
C41	01A01000	CAP CER 1000PF 0MV 1KV
C42	01H52200A	CAP AL ELEC 220uF -10 +50% 25V
C43	01A14700	CAP CER .047uF 20% 50V
C44	01H52200A	CAP AL ELEC 220uF -10 +50% 25V
C45	01A14700	CAP CER .047uF 20% 50V
C46	01H52200A	CAP AL ELEC 220uF -10 +50% 25V
C47	01A14700	CAP CER .047uF 20% 50V
C49	01A11000	CAP CER .01uF 20% 50V
C50	01A11000	CAP CER .01uF 20% 50V
C51	01A11000	CAP CER .01uF 20% 50V
C52	01A11000	CAP CER .01uF 20% 50V
C53	01A11000	CAP CER .01uF 20% 50V
C54	01A11000	CAP CER .01uF 20% 50V
C55	01A11000	CAP CER .01uF 20% 50V
C56	01A11000	CAP CER .01uF 20% 50V
C57	01A11000	CAP CER .01uF 20% 50V

DOC NO: **PARTS LIST BY ASSEMBLY** DATE: 5/12/81
ASSEMBLY NO: D41-01-2
DESCRIPTION: GENERATOR PC BD ASSY (202)

REF DES./QTY	STOCK NO.	DESCRIPTION
C58	01A11000	CAP CER .01uF 20% 50V
C59	01A11000	CAP CER .01uF 20% 50V
C60	01A11000	CAP CER .01uF 20% 50V
C61	01A11000	CAP CER .01uF 20% 50V
C62	01A11000	CAP CER .01uF 20% 50V
C63	01A11000	CAP CER .01uF 20% 50V
C64	01A11000	CAP CER .01uF 20% 50V
C65	01A11000	CAP CER .01uF 20% 50V
C66	01A11000	CAP CER .01uF 20% 50V
C67	01A11000	CAP CER .01uF 20% 50V
C68	01A11000	CAP CER .01uF 20% 50V
C69	01A11000	CAP CER .01uF 20% 50V
C70	01A11000	CAP CER .01uF 20% 50V
D1	03C00823A	DIODE ZENER 1N823A 6.2V 5%
D2	03A03064	DIODE SIGNAL 1N3064 75V
D3	03A03064	DIODE SIGNAL 1N3064 75V
D4	03A03064	DIODE SIGNAL 1N3064 75V
D5	03A03064	DIODE SIGNAL 1N3064 75V
D6	03A03064	DIODE SIGNAL 1N3064 75V
D8	03A03064	DIODE SIGNAL 1N3064 75V
D9	03A03064	DIODE SIGNAL 1N3064 75V
D10	03A03064	DIODE SIGNAL 1N3064 75V
D11	03A03064	DIODE SIGNAL 1N3064 75V
D12	03A03064	DIODE SIGNAL 1N3064 75V
D13	03A03064	DIODE SIGNAL 1N3064 75V
D14	03A03064	DIODE SIGNAL 1N3064 75V
D15	03A03064	DIODE SIGNAL 1N3064 75V
D16	03A03064	DIODE SIGNAL 1N3064 75V
D17	03A03064	DIODE SIGNAL 1N3064 75V
D18	03A03064	DIODE SIGNAL 1N3064 75V
D19	03J00001	DIODE BRIDGE KBP04 400V 1.5A
D20	03A03064	DIODE SIGNAL 1N3064 75V
D21	03A03064	DIODE SIGNAL 1N3064 75V
IC2	08B04558	IC OP AMP 4558
IC3	07014501	IC CMOS 14501UB
IC6	07004013A	IC CMOS 4013B
IC7	07004011A1	IC CMOS 4011B
IC8	07004518	IC CMOS 4518B
IC9	07004518	IC CMOS 4518B
IC10	07004520	IC CMOS 4520B
IC11	07004520	IC CMOS 4520B
IC12	07004012A	IC CMOS 4012B
IC13	07004011A	IC CMOS 4011B
IC14	07004518	IC CMOS 4518B
IC15	08B04558	IC OP AMP 4558
IC16	08A00356	IC OP AMP 356
IC17	07004011A	IC CMOS 4011B
IC18	07004011A	IC CMOS 4011B
IC19	07004518	IC CMOS 4518B
IC20	07004013A	IC CMOS 4013B
IC21	07004011A	IC CMOS 4011B
IC22	07004011A	IC CMOS 4011B
IC23	07004011A	IC CMOS 4011B
IC24	07K05005	IC PMOS 5005

DOC NO: **PARTS LIST BY ASSEMBLY** DATE: 5/12/81
ASSEMBLY NO: D41-01-2
DESCRIPTION: GENERATOR PC BD ASSY (202)

REF DES./QTY	STOCK NO.	DESCRIPTION
IC25	08B04558	IC OP AMP 4558
IC26	07G04046	IC CMOS 4046B
IC27	08B04558	IC OP AMP 4558
IC28	08B04558	IC OP AMP 4558
IC29	07G04011A	IC CMOS 4011B
IC30	07G04510	IC CMOS 4510B
IC31	07G04013A	IC CMOS 4013B
IC32	07G04028A	IC CMOS 4028B
IC33	08B04558	IC OP AMP 4558
IC34	08B04558	IC OP AMP 4558
IC35	07G04066	IC CMOS 4066B
IC36	07G04066	IC CMOS 4066B
IC37	07G04066	IC CMOS 4066B
IC38	08A00356	IC OP AMP 356
IC39	08A00356	IC OP AMP 356
IC40	08A00356	IC OP AMP 356
IC41	10C03085	IC REGULATOR 3085A
IC42	10C03085	IC REGULATOR 3085A
IC43	08B04558	IC OP AMP 4558
Q1	05C04401	TRANSISTOR NPN 2N4401
Q2	05A04403	TRANSISTOR PNP 2N4403
Q3	05C02484	TRANSISTOR NPN 2N2484
Q4	05A04403	TRANSISTOR PNP 2N4403
Q5	05C04401	TRANSISTOR NPN 2N4401
Q6	05D00008	TRANSISTOR NPN MPS-A18
Q7	05C02369	TRANSISTOR NPN 2N2369
Q8	05C04401	TRANSISTOR NPN 2N4401
Q9	05C04401	TRANSISTOR NPN 2N4401
Q10	05C04401	TRANSISTOR NPN 2N4401
Q11	05D00007	TRANSISTOR NPN MPS-A14
Q12	05D00007	TRANSISTOR NPN MPS-A14
Q13	05D00007	TRANSISTOR NPN MPS-A14
Q14	05D00007	TRANSISTOR NPN MPS-A14
Q15	05C04401	TRANSISTOR NPN 2N4401
Q16	05C04401	TRANSISTOR NPN 2N4401
Q17	05C04401	TRANSISTOR NPN 2N4401
Q18	05C04401	TRANSISTOR NPN 2N4401
Q19	05C04401	TRANSISTOR NPN 2N4401
Q20	05C04401	TRANSISTOR NPN 2N4401
Q25	05C04401	TRANSISTOR NPN 2N4401
R1	12F11000	RES METAL FILM 10.0K 1% 1/4W
R2	12F11000	RES METAL FILM 10.0K 1% 1/4W
R4	12B11000	RES CARBON 10K 5% 1/4W
R5	12FD5620	RES METAL FILM 562 OHM 1% 1/4W
R6	12F21820	RES METAL FILM 182K 1% 1/4W
R8	12B13600	RES CARBON 36K 5% 1/4W
R9	12B11000	RES CARBON 10K 5% 1/4W
R10	13A12000	RES METAL FILM 20K 10% .75W 15 TURN
R11	12B11000	RES CARBON 10K 5% 1/4W
R12	12FD3570	RES METAL FILM 357 OHM 1% 1/4W
R13	12FD3740	RES METAL FILM 374 OHM 1% 1/4W
R14	12F21210	RES METAL FILM 121K 1% 1/4W
R15	13A02000	RES METAL FILM 2K 10% .5W 1 TURN
R16	12F03480	RES METAL FILM 3.48K 1% 1/4W

DOC NO: **PARTS LIST BY ASSEMBLY** DATE: 5/12/81
ASSEMBLY NO: D41-01-2
DESCRIPTION: GENERATOR PC BD ASSY (202)

REF DES./QTY	STOCK NO.	DESCRIPTION
R17	12B12000	RES CARBON 20K 5% 1/4W
R18	12B21000	RES CARBON 100K 5% 1/4W
R19	12B12400	RES CARBON 24K 5% 1/4W
R20	12B12000	RES CARBON 20K 5% 1/4W
R21	12B05100	RES CARBON 5.1K 5% 1/4W
R22	12B15100	RES CARBON 51K 5% 1/4W
R23	12B15100	RES CARBON 51K 5% 1/4W
R25	12B41000	RES CARBON 10M 5% 1/4W
R26	12B02000	RES CARBON 2K 5% 1/4W
R27	12B06200	RES CARBON 6.2K 5% 1/4W
R28	12B21600	RES CARBON 160K 5% 1/4W
R29	12B11000	RES CARBON 10K 5% 1/4W
R30	12B11200	RES CARBON 12K 5% 1/4W
R31	12B16800	RES CARBON 68K 5% 1/4W
R32	12B21000	RES CARBON 100K 5% 1/4W
R33	12B16800	RES CARBON 68K 5% 1/4W
R34	12B21000	RES CARBON 100K 5% 1/4W
R35	12B21000	RES CARBON 100K 5% 1/4W
R36	12B16800	RES CARBON 68K 5% 1/4W
R37	12B16800	RES CARBON 68K 5% 1/4W
R39	12B21000	RES CARBON 100K 5% 1/4W
R40	12B31000	RES CARBON 1.0M 5% 1/4W
R41	12B11000	RES CARBON 10K 5% 1/4W
R42	12BD5100	RES CARBON 510 OHM 5% 1/4W
R43	12B11200	RES CARBON 12K 5% 1/4W
R44	12B01500	RES CARBON 1.5K 5% 1/4W
R45	12F22150	RES METAL FILM 215K 1% 1/4W
R46	12FD8250	RES METAL FILM 825 OHM 1% 1/4W
R47	12F23090	RES METAL FILM 309K 1% 1/4W
R48	13A15000	RES METAL FILM 50K 10% .5W 1 TURN
R49	12F06190	RES METAL FILM 6.19K 1% 1/4W
R50	12FD8250	RES METAL FILM 825 OHM 1% 1/4W
R51	12F23090	RES METAL FILM 309K 1% 1/4W
R52	13A15000	RES METAL FILM 50K 10% .5W 1 TURN
R53	13A15000	RES METAL FILM 50K 10% .5W 1 TURN
R54	12B21000	RES CARBON 100K 5% 1/4W
R55	12B11000	RES CARBON 10K 5% 1/4W
R56	12B21000	RES CARBON 100K 5% 1/4W
R57	12F12000	RES METAL FILM 20.0K 1% 1/4W
R58	12B14700	RES CARBON 47K 5% 1/4W
R59	12F11000	RES METAL FILM 10.0K 1% 1/4W
R60	12F13320	RES METAL FILM 33.2K 1% 1/4W
R61	12B32400	RES CARBON 2.4M 5% 1/4W
R62	12B32400	RES CARBON 2.4M 5% 1/4W
R63	12F11000	RES METAL FILM 10.0K 1% 1/4W
R64	12F21000	RES METAL FILM 100K 1% 1/4W
R65	12F21000	RES METAL FILM 100K 1% 1/4W
R66	12F12000	RES METAL FILM 20.0K 1% 1/4W
R67	12F11000	RES METAL FILM 10.0K 1% 1/4W
R68	12F31000	RES METAL FILM 1.00M 1% 1/4W
R69	13A11000	RES METAL FILM 10K 10% .5W 1 TURN
R70	12F01000	RES METAL FILM 1.00K 1% 1/4W
R71	12F26340	RES METAL FILM 634K 1% 1/4W
R72	12J22139	RES METAL FILM 213.9K .1% 1/10W

DOC NO: **PARTS LIST BY ASSEMBLY** DATE: 5/12/81
ASSEMBLY NO: D41-01-2
DESCRIPTION: GENERATOR PC BD ASSY (202)

REF DES./QTY	STOCK NO.	DESCRIPTION
R73	12J21304	RES METAL FILM 130.4K .1% 1/10W
R74	12J19544	RES METAL FILM 95.44K .1% 1/10W
R75	12J17674	RES METAL FILM 76.74K .1% 1/10W
R76	12J16550	RES METAL FILM 65.50K .1% 1/10W
R77	12J15839	RES METAL FILM 58.39K .1% 1/10W
R78	12J15387	RES METAL FILM 53.87K .1% 1/10W
R79	12J15117	RES METAL FILM 51.17K .1% 1/10W
R80	12J14990	RES METAL FILM 49.90K .1% 1/10W
R81	13A05000	RES METAL FILM 5K 10% .5W 1 TURN
R82	12B23000	RES CARBON 300K 5% 1/4W
R83	12B21000	RES CARBON 100K 5% 1/4W
R84	12B23000	RES CARBON 300K 5% 1/4W
R85	13A21000A	RES METAL FILM 100K 10% .5W 1 TURN
R86	12F31000	RES METAL FILM 1.00M 1% 1/4W
R87	12F11000	RES METAL FILM 10.0K 1% 1/4W
R88	12F06040	RES METAL FILM 6.04K 1% 1/4W
R89	12F11000	RES METAL FILM 10.0K 1% 1/4W
R90	12F11000	RES METAL FILM 10.0K 1% 1/4W
R91	12F09530	RES METAL FILM 9.53K 1% 1/4W
R92	13A01000A	RES METAL FILM 1K 10% .5W 1 TURN
R93	12F21330	RES METAL FILM 133K 1% 1/4W
R94	12F13650	RES METAL FILM 36.5K 1% 1/4W
R95	12F07500	RES METAL FILM 7.50K 1% 1/4W
R96	12F01500	RES METAL FILM 1.50K 1% 1/4W
R97	12F21330	RES METAL FILM 133K 1% 1/4W
R98	12F13650	RES METAL FILM 36.5K 1% 1/4W
R99	12F07500	RES METAL FILM 7.50K 1% 1/4W
R100	12F01500	RES METAL FILM 1.50K 1% 1/4W
R101	12F21330	RES METAL FILM 133K 1% 1/4W
R102	12F13650	RES METAL FILM 36.5K 1% 1/4W
R103	12F07500	RES METAL FILM 7.50K 1% 1/4W
R104	12F01500	RES METAL FILM 1.50K 1% 1/4W
R105	12F12550	RES METAL FILM 25.5K 1% 1/4W
R106	12FD1370	RES METAL FILM 137 OHM 1% 1/4W
R107	12F23160	RES METAL FILM 316K 1% 1/4W
R108	12B31000	RES CARBON 1.0M 5% 1/4W
R109	12F11020	RES METAL FILM 10.2K 1% 1/4W
R110	12FD3400	RES METAL FILM 340 OHM 1% 1/4W
R111	12F23570	RES METAL FILM 357K 1% 1/4W
R112	12B31000	RES CARBON 1.0M 5% 1/4W
R113	12F02870	RES METAL FILM 2.87K 1% 1/4W
R114	12FD5620	RES METAL FILM 562 OHM 1% 1/4W
R115	12F23570	RES METAL FILM 357K 1% 1/4W
R116	12B31000	RES CARBON 1.0M 5% 1/4W
R119	12F11000	RES METAL FILM 10.0K 1% 1/4W
R120	12F12000	RES METAL FILM 20.0K 1% 1/4W
R122	12B11000	RES CARBON 10K 5% 1/4W
R123	12B11000	RES CARBON 10K 5% 1/4W
R124	12B12000	RES CARBON 20K 5% 1/4W
R125	12B12000	RES CARBON 20K 5% 1/4W
R126	12B12000	RES CARBON 20K 5% 1/4W
R127	12B12000	RES CARBON 20K 5% 1/4W
R128	12B11000	RES CARBON 10K 5% 1/4W
R129	12B11000	RES CARBON 10K 5% 1/4W

DOC NO: **PARTS LIST BY ASSEMBLY** DATE: 5/12/81
ASSEMBLY NO: D41-01-2
DESCRIPTION: GENERATOR PC BD ASSY (202)

REF DES./QTY	STOCK NO.	DESCRIPTION
R130	12B11000	RES CARBON 10K 5% 1/4W
R131	12B11000	RES CARBON 10K 5% 1/4W
R132	12B11000	RES CARBON 10K 5% 1/4W
R133	12B11000	RES CARBON 10K 5% 1/4W
R134	12B11000	RES CARBON 10K 5% 1/4W
R135	12BC6800	RES CARBON 68 OHM 5% 1/4W
R136	12BC6800	RES CARBON 68 OHM 5% 1/4W
R137	12BC6800	RES CARBON 68 OHM 5% 1/4W
R138	12BC6800	RES CARBON 68 OHM 5% 1/4W
R139	12BC6800	RES CARBON 68 OHM 5% 1/4W
R140	12BC6800	RES CARBON 68 OHM 5% 1/4W
R141	12BC6800	RES CARBON 68 OHM 5% 1/4W
R142	12B04700	RES CARBON 4.7K 5% 1/4W
R143	12B21000	RES CARBON 100K 5% 1/4W
R144	12B11000	RES CARBON 10K 5% 1/4W
R145	12B11200	RES CARBON 12K 5% 1/4W
R146	12B11200	RES CARBON 12K 5% 1/4W
R147	12BC6800	RES CARBON 68 OHM 5% 1/4W
R148	12BC6800	RES CARBON 68 OHM 5% 1/4W
R149	12B21000	RES CARBON 100K 5% 1/4W
R150	12F11000	RES METAL FILM 10.0K 1% 1/4W
R151	12BC7500	RES CARBON 75 OHM 5% 1/4W
R152	13A01000A	RES METAL FILM 1K 10% .5W 1 TURN
R153	12F11000	RES METAL FILM 10.0K 1% 1/4W
R154	12FD5360	RES METAL FILM 536 OHM 1% 1/4W
R155	12F11000	RES METAL FILM 10.0K 1% 1/4W
R156	12BB0200	RES CARBON 0.2 OHM 5% 1/4W
R157	12F01000	RES METAL FILM 1.00K 1% 1/4W
R158	12LA5600	RES WIREWOUND .56 OHM 10% 2W
R159	12F06340	RES METAL FILM 6.34K 1% 1/4W
R160	13A01000A	RES METAL FILM 1K 10% .5W 1 TURN
R161	12F02940	RES METAL FILM 2.94K 1% 1/4W
R162	12B21000	RES CARBON 100K 5% 1/4W
R163	12B22400	RES CARBON 240K 5% 1/4W
R164	12F11000	RES METAL FILM 10.0K 1% 1/4W
R165	12F11000	RES METAL FILM 10.0K 1% 1/4W
R166	12B03900	RES CARBON 3.9K 5% 1/4W
R167	12B13900	RES CARBON 39K 5% 1/4W
R168	12B03900	RES CARBON 3.9K 5% 1/4W
R169	12B13900	RES CARBON 39K 5% 1/4W
R170	12F11180	RES METAL FILM 11.8K 1% 1/4W
Y1	16A00016	TRANSFORMER SIGNAL 600:600
Y1	25A00005	CRYSTAL 2.0MHZ 32 PF
1	19E00019	CONN MOLEX 2 CONTACT
2	19L00034	CONN 18 CONTACT
4	19R00003	CONN TERMINAL
16	19R00004	CONN TERMINAL
11	19Z00003	CONN WIRE JUMPERS
1	20A00005	SOCKET IC 16 PIN
4	F-HLI-050	B CAPACITOR SPACER
REF	D41-203C-1	COMPONENT LAYOUT
REF	R41-204F	SCHEMATIC DIAGRAM
		------ END OF FILE ------

DOC NO: **PARTS LIST BY ASSEMBLY** DATE: 5/12/81
ASSEMBLY NO: D41-01-3
DESCRIPTION: DISPLAY PC BD ASSY (302)

REF DES./QTY	STOCK NO.	DESCRIPTION
DS1	11C00002	DISPLAY LED MAN4605
DS2	11B00003	DISPLAY LED MAN4640
DS3	11B00003	DISPLAY LED MAN4640
DS4	11B00003	DISPLAY LED MAN4640
DS5	11B00003	DISPLAY LED MAN4640
DS6	11B00003	DISPLAY LED MAN4640
DS7	11B00003	DISPLAY LED MAN4640
DS8	11B00003	DISPLAY LED MAN4640
FC2	19H00010	CABLE FLAT 24 CONTACT 6 IN
FC3	19H00009	CABLE FLAT 18 CONTACT 6 IN
R1	12BD2700	RES CARBON 270 OHM 5% 1/4W
8	20A00004	SOCKET IC 14 PIN
2	23A00002	SPACER SPLIT ROLLED 4 X 1/4 STD-AK
2	24A04006A	SCREW 4-40 X 3/8 BH-SL-SMP
4	24A04102	WASHER FLAT #4 SCP
2	24A04104	WASHER EXT TOOTH #4
1	F41-302C	B P.C. D&T DISPLAY
REF	B41-303C	COMPONENT LAYOUT
REF	D41-304C	SCHEMATIC DIAGRAM
		------ END OF FILE -----

DOC NO: **PARTS LIST BY ASSEMBLY** DATE: 5/12/81
ASSEMBLY NO: D41-01-4
DESCRIPTION: SWITCH PC BD ASSY (402)

REF DES./QTY	STOCK NO.	DESCRIPTION
C1	01H47500	CAP AL ELEC 75uF -10 +50% 100V
C2	01H47500	CAP AL ELEC 75uF -10 +50% 100V
C3	01G32200	CAP TANT ELEC 2.2uF 10% 20V
C4	01H44700	CAP AL ELEC 47uF -10 +100% 35V
C5	01H44700	CAP AL ELEC 47uF -10 +100% 35V
C8	01H47500	CAP AL ELEC 75uF -10 +50% 100V
C9	01H47500	CAP AL ELEC 75uF -10 +50% 100V
C10	01A11000	CAP CER .01uF 20% 50V
C11	01A11000	CAP CER .01uF 20% 50V
C12	01G42200	CAP TANT ELEC 22uF 10% 15V
C13	01A11000	CAP CER .01uF 20% 50V
C14	01A11000	CAP CER .01uF 20% 50V
C15	01A11000	CAP CER .01uF 20% 50V
D3	03A03064	DIODE SIGNAL 1N3064 75V
FC1	19H00006	CABLE FLAT 18 CONTACT 4 IN
FC4	19H00006	CABLE FLAT 18 CONTACT 4 IN
IC1	08B04558	IC OP AMP 4558
IC2	08B04558	IC OP AMP 4558
Q1	05C04401	TRANSISTOR NPN 2N4401
Q2	05A04403	TRANSISTOR PNP 2N4403
R1	12F05360	RES METAL FILM 5.36K 1% 1/4W
R2	12F11000	RES METAL FILM 10.0K 1% 1/4W
R3	12F09090	RES METAL FILM 9.09K 1% 1/4W
R4	13A02000A1	RES METAL FILM 2K 10% .75W 15 TURN
R6	12F11000	RES METAL FILM 10.0K 1% 1/4W
R9	12F12370	RES METAL FILM 23.7K 1% 1/4W
R10	12LD6190	RES WIREWOUND 619 OHM 1% 3W
R11	12LD9310	RES WIREWOUND 931 OHM 1% 3W
R12	12B21000	RES CARBON 100K 5% 1/4W
R13	12B15100	RES CARBON 51K 5% 1/4W
R14	12CC3300	RES CARBON 33 OHM 5% 1/2W
R15	12CC3300	RES CARBON 33 OHM 5% 1/2W
R16	12F01000	RES METAL FILM 1.00K 1% 1/4W
R17	12F13090	RES METAL FILM 30.9K 1% 1/4W
R18	12F02490	RES METAL FILM 2.49K 1% 1/4W
R19	12F22870	RES METAL FILM 287K 1% 1/4W
R20	12F22740	RES METAL FILM 274K 1% 1/4W
R21	12F23010	RES METAL FILM 301K 1% 1/4W
R24	12B12000	RES CARBON 20K 5% 1/4W
R25	12B12000	RES CARBON 20K 5% 1/4W
R26	12F11000	RES METAL FILM 10.0K 1% 1/4W
S1-10	F41-050	B SWITCH ASSEMBLY, SPEC CONTROL DWG
S11-20	F41-051	B SWITCH ASSEMBLY, SPEC CONTROL DWG
23	19R00004	CONN TERMINAL
2	19Z00003	CONN WIRE JUMPERS
19	21Z00004	SWITCH CAP GRAY/GREEN/CLEAR
1	21Z00013	SWITCH CAP GRAY/ORANGE/CLEAR
1	23E00006	BUMPER FEET ROUND
1	F41-402H	C PC D&T SWITCH BOARD
REF	D41-403-01H-1	COMPONENT LAYOUT
REF	D41-404H-2	SCHEMATIC DIAGRAM
		------ END OF FILE -----

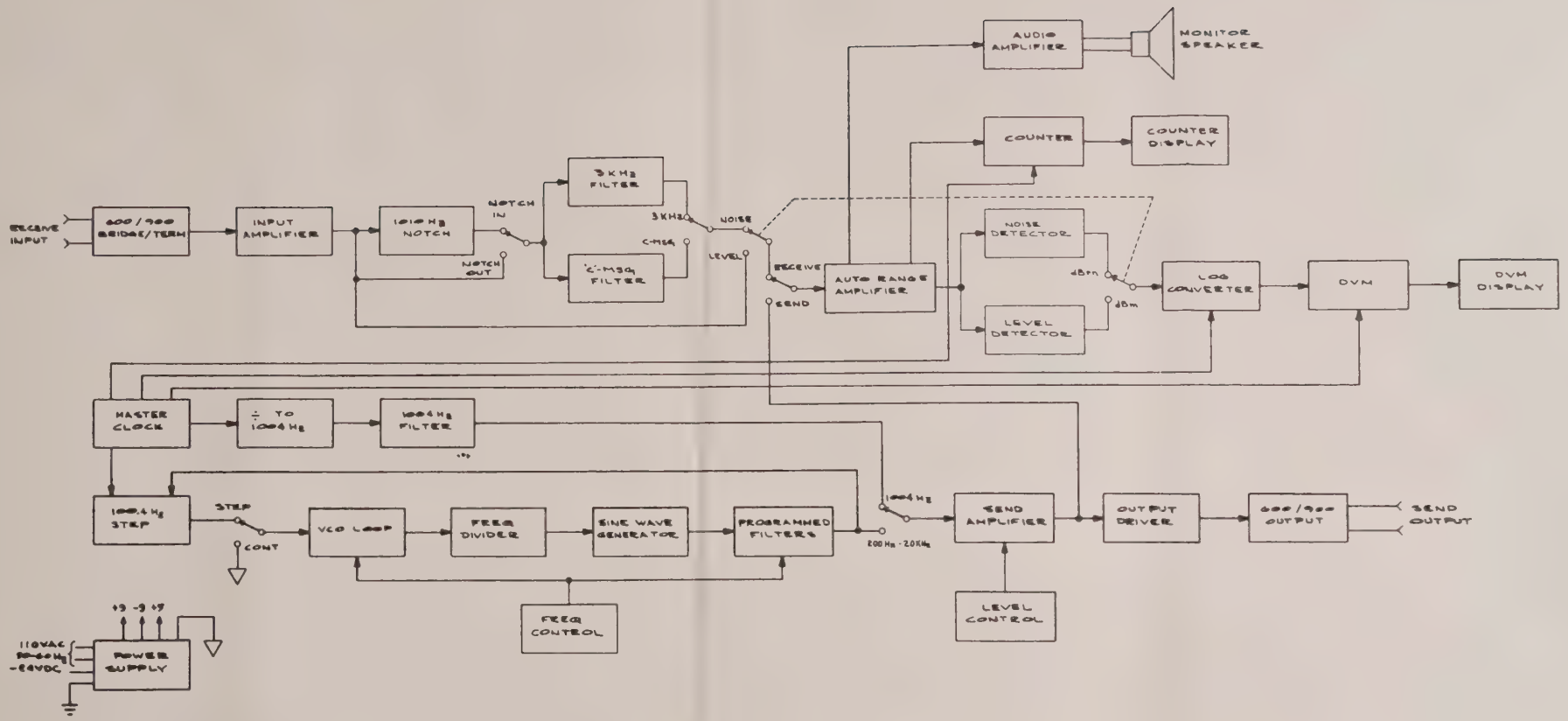


FIGURE 5-1. MODEL 41-01 BLOCK DIAGRAM

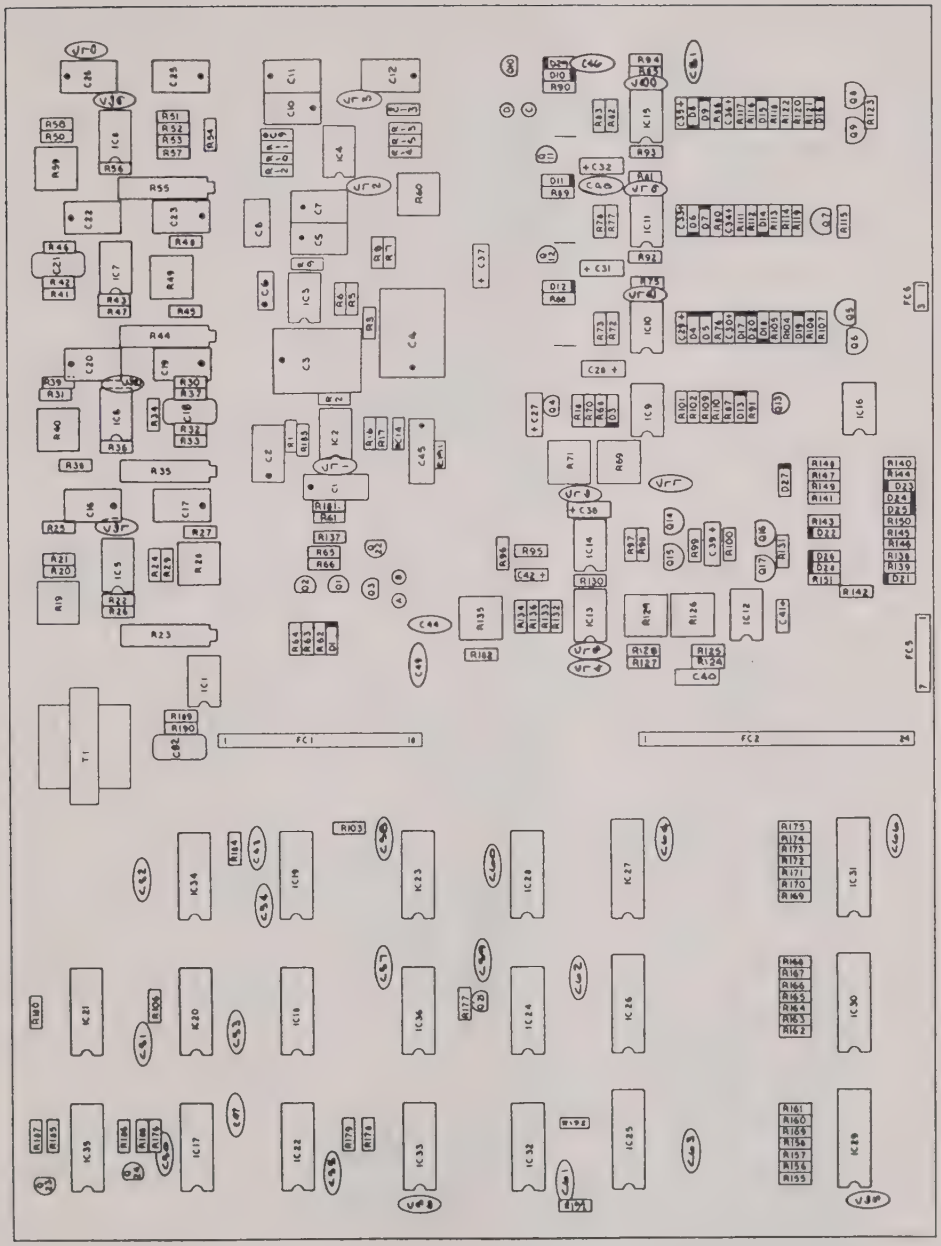


FIGURE 5-2. RECEIVER COMPONENT LAYOUT

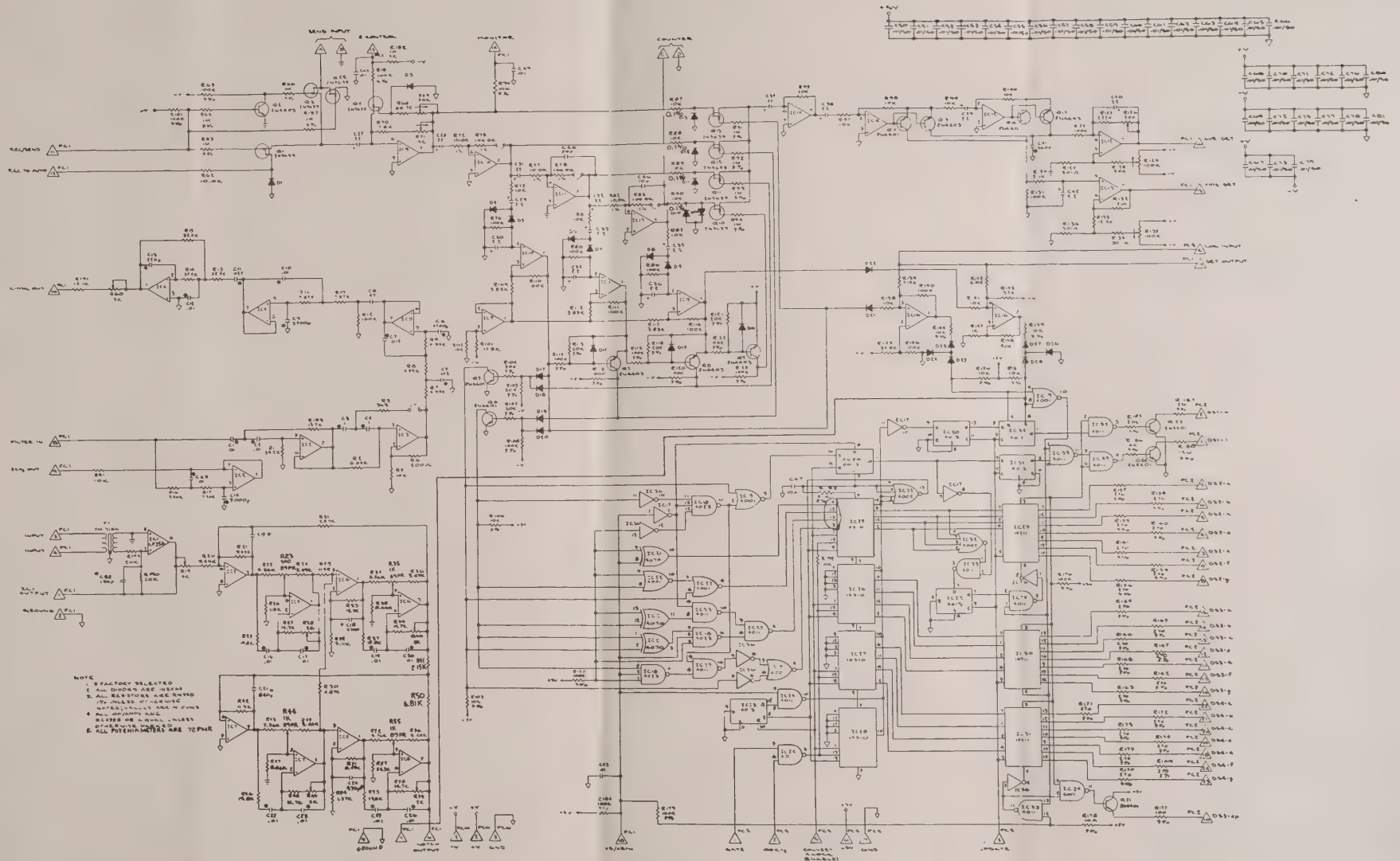


FIGURE 5-3. RECEIVER SCHEMATIC DIAGRAM

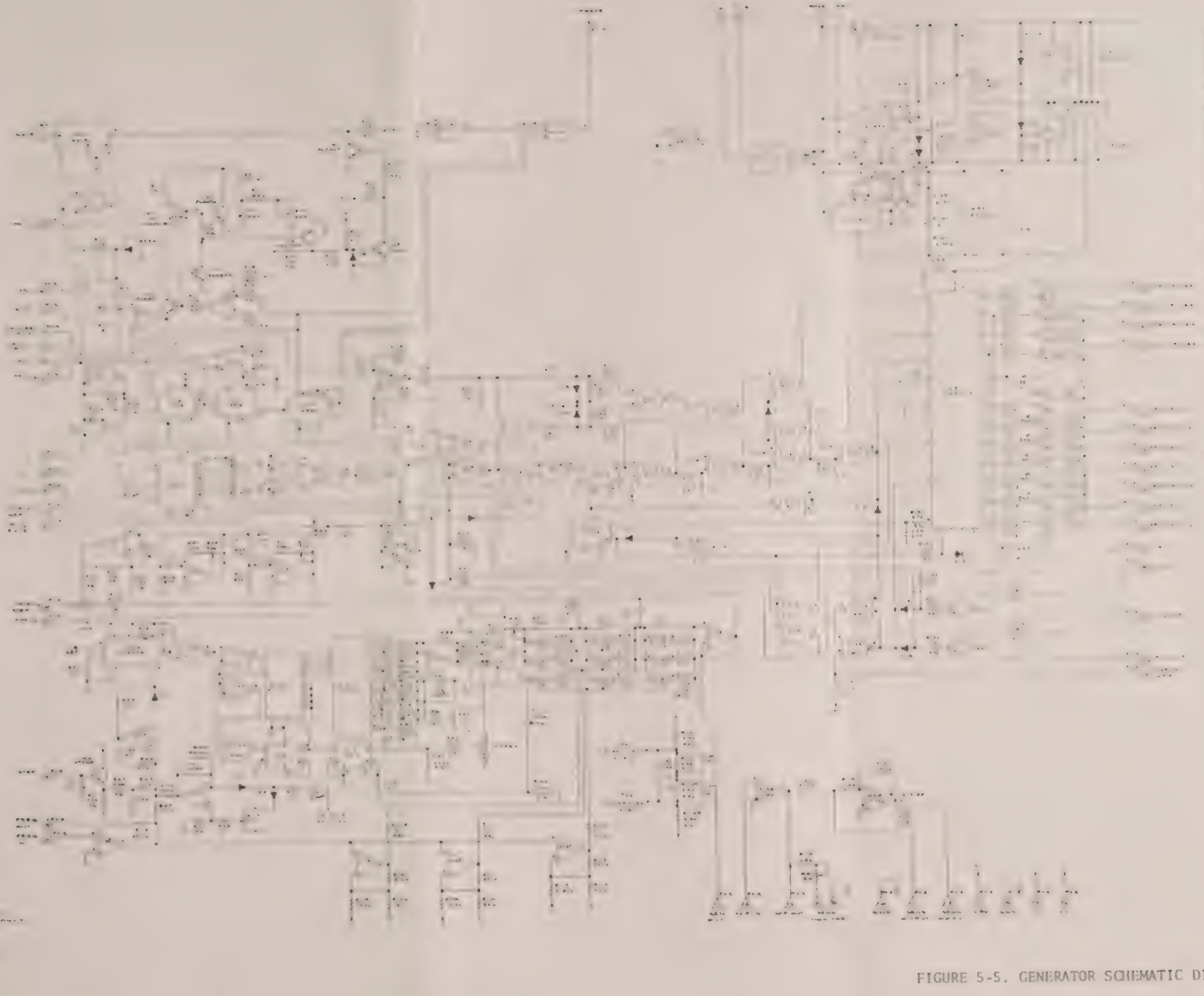


FIGURE 5-5. GENERATOR SCHEMATIC DIAGRA

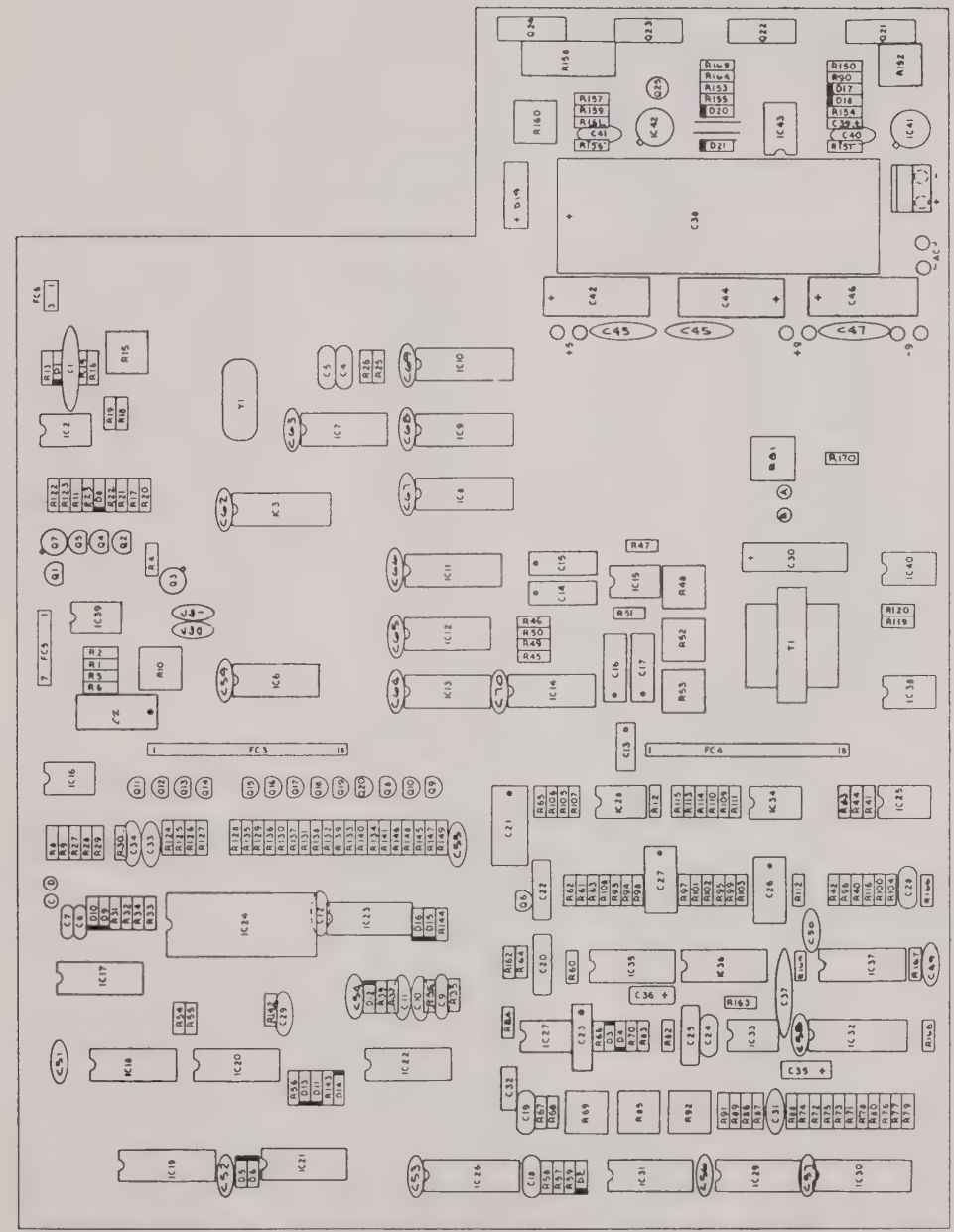


FIGURE 5-4. GENERATOR COMPONENT LAYOUT

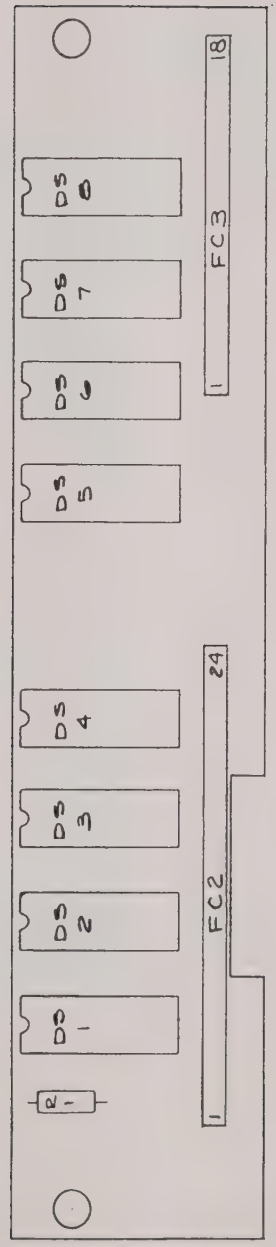
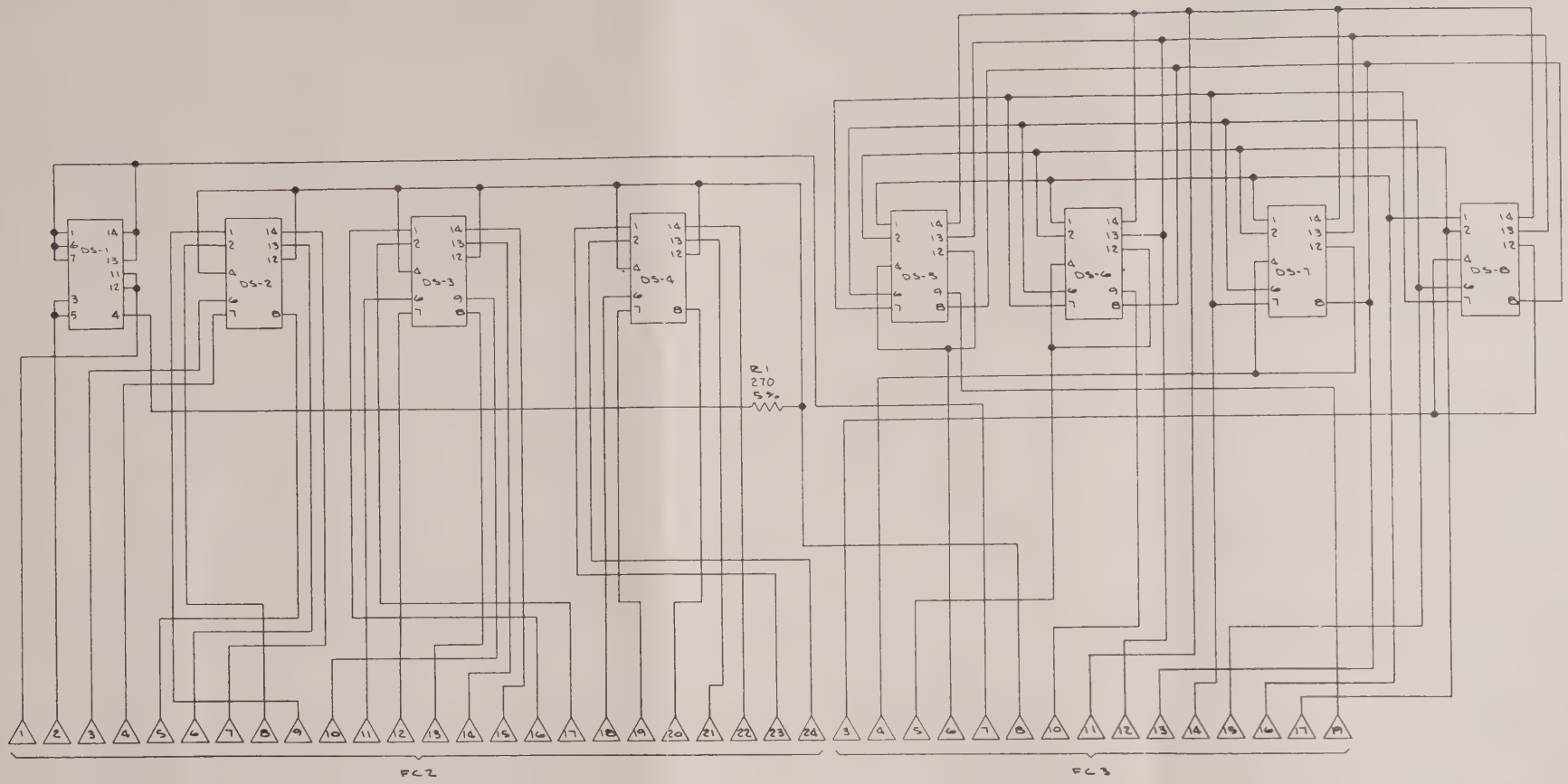


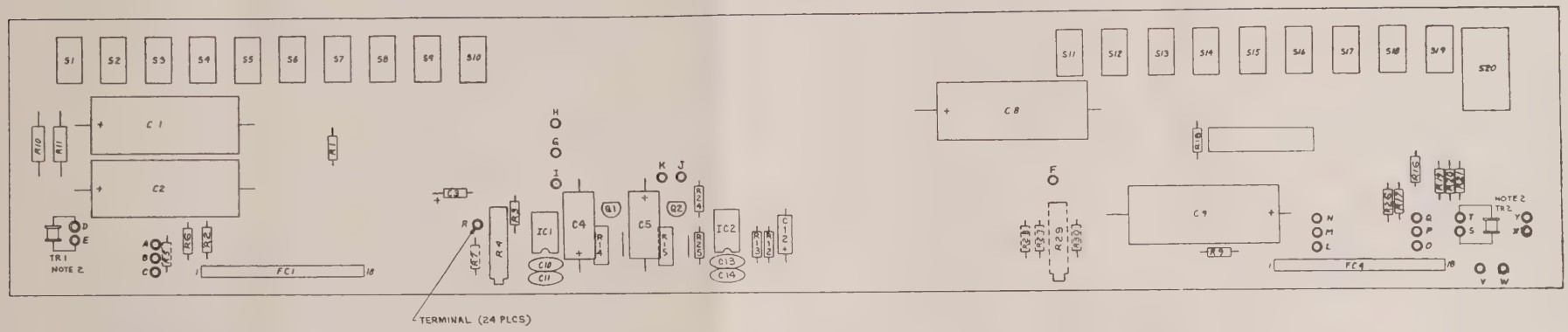
FIGURE 5-6. DISPLAY COMPONENT LAYOUT



NOTES:

UNLESS OTHERWISE SPECIFIED;
1. DS-1 - MAN6202A,
   DS2-DS8 - MAN6402A
2. NO CONNECTION TO FC3-1, FC3-8, FC3-9, FC3-18

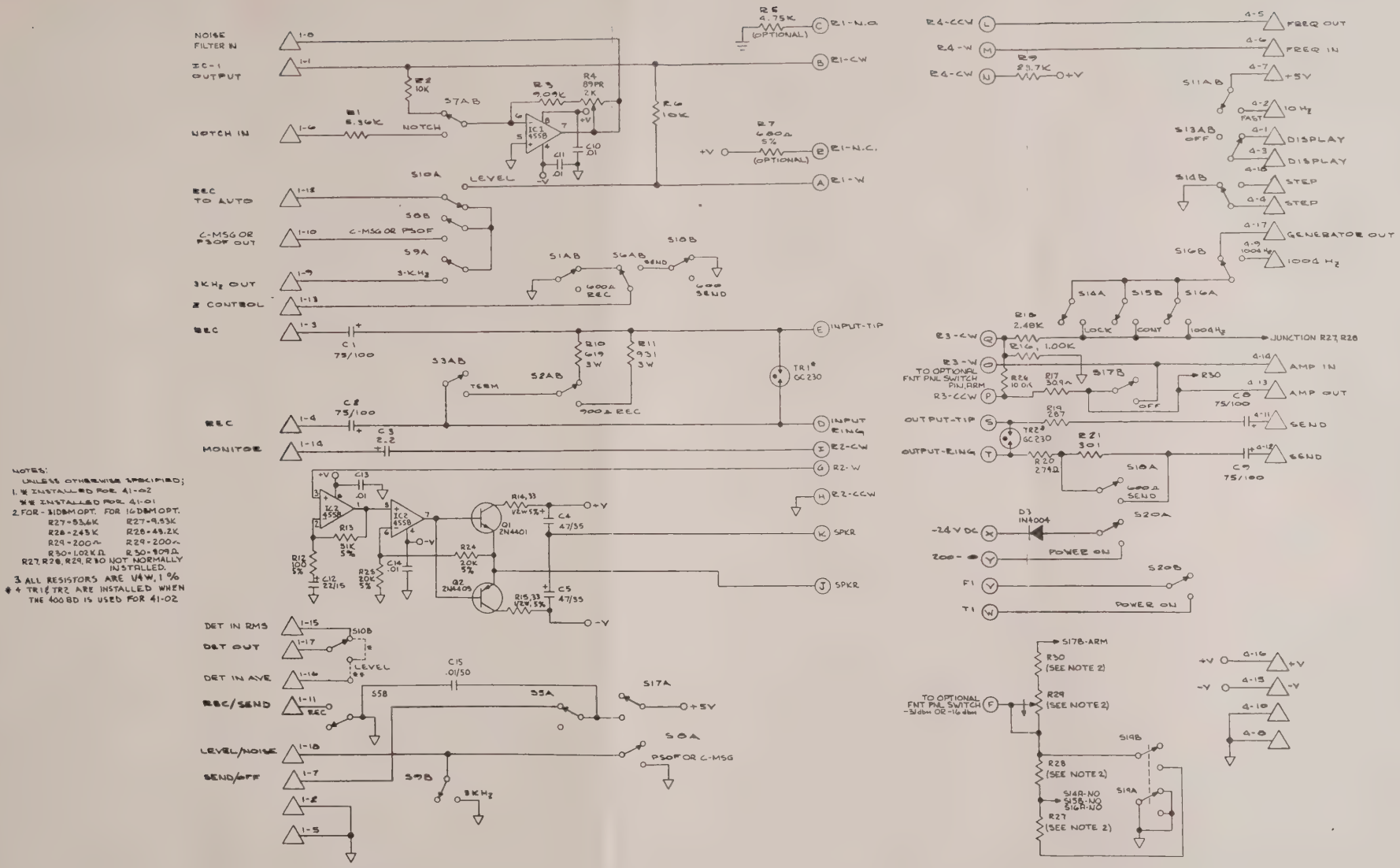
FIGURE 5-7. DISPLAY SCHEMATIC DIAGRAM



NOTES:

1. R5, R7, R27, R28, R29 AND R30 ARE OPTIONAL COMPONENTS AND NOT NORMALLY INSTALLED.
2. TR1 & TR2 (SPARK CAP-CA230) ARE INSTALLED WHEN THE 400 BD IS USE FOR THE 41-02.

FIGURE 5-8. SWITCH COMPONENT LAYOUT



NOTES:
UNLESS OTHERWISE SPECIFIED;
1. * INSTALLED FOR 41-02
** INSTALLED FOR 41-01
2. FOR -30DBM OPT. FOR 16DBM OPT.
R27 = 53.6K R27 = 9.53K
R28 = 24.3K R28 = 49.2K
R29 = 200Ω R29 = 200Ω
R30 = 1.02KΩ R30 = 909Ω
R27, R28, R29, R30 NOT NORMALLY INSTALLED.
3. ALL RESISTORS ARE 1/4W, 1%
4 TRIAC TR2 ARE INSTALLED WHEN THE 600 BD IS USED FOR 41-02

FIGURE 5-9. SWITCH SCHEMATIC DIAGRAM

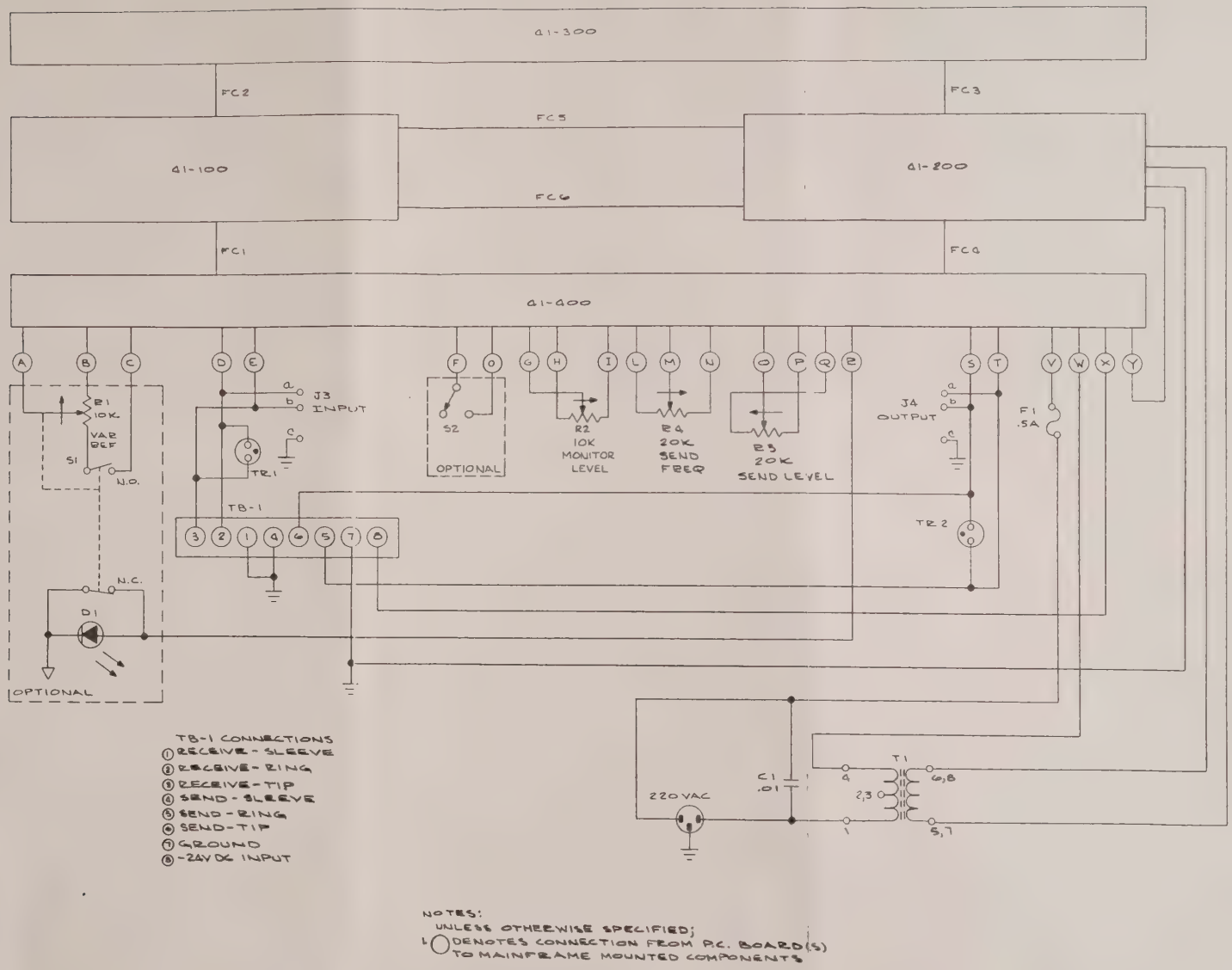


FIGURE 5-10. INTERCONNECT DIAGRAM

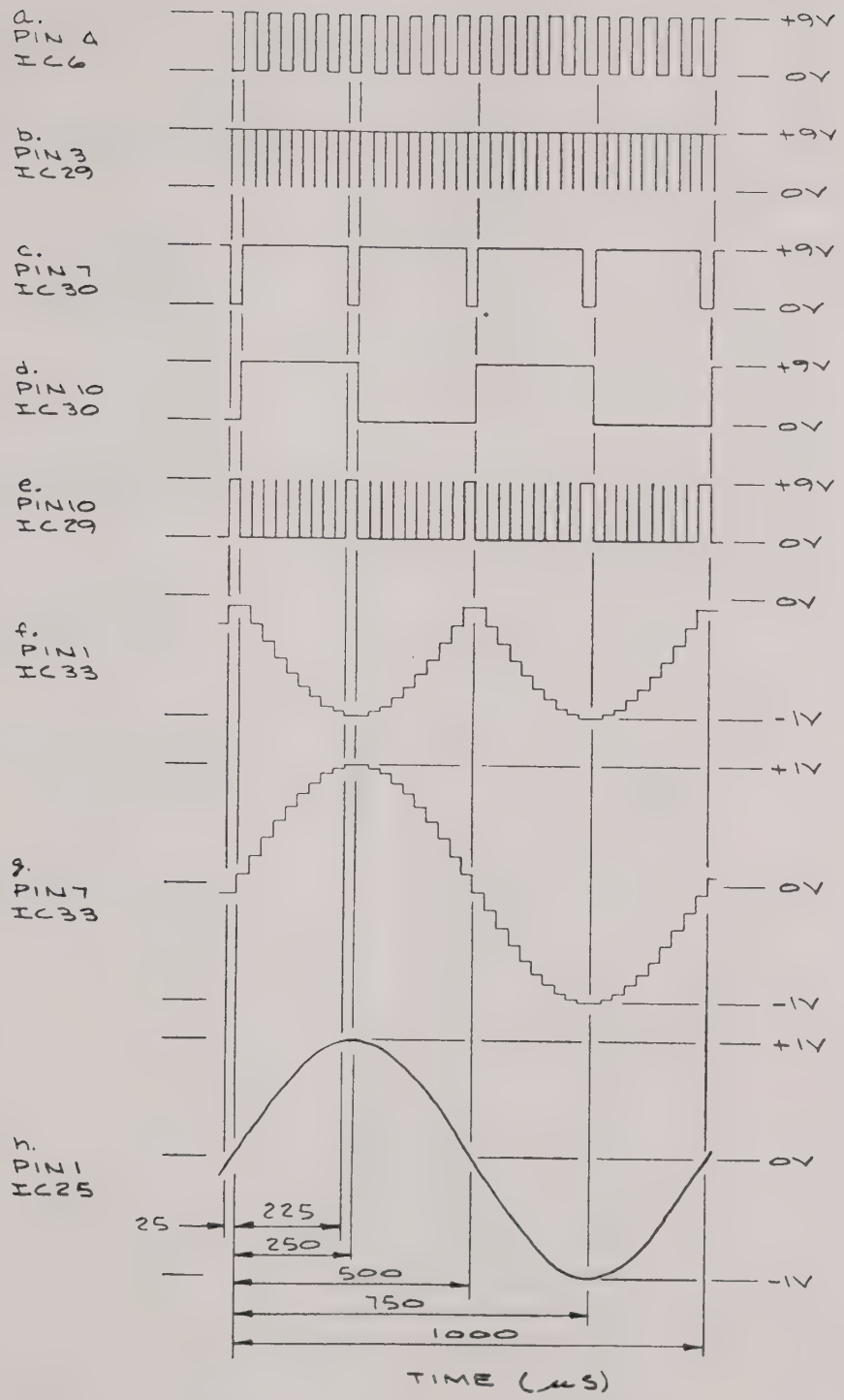


FIGURE 5-11. FREQUENCY GENERATOR TIMING DIAGRAM

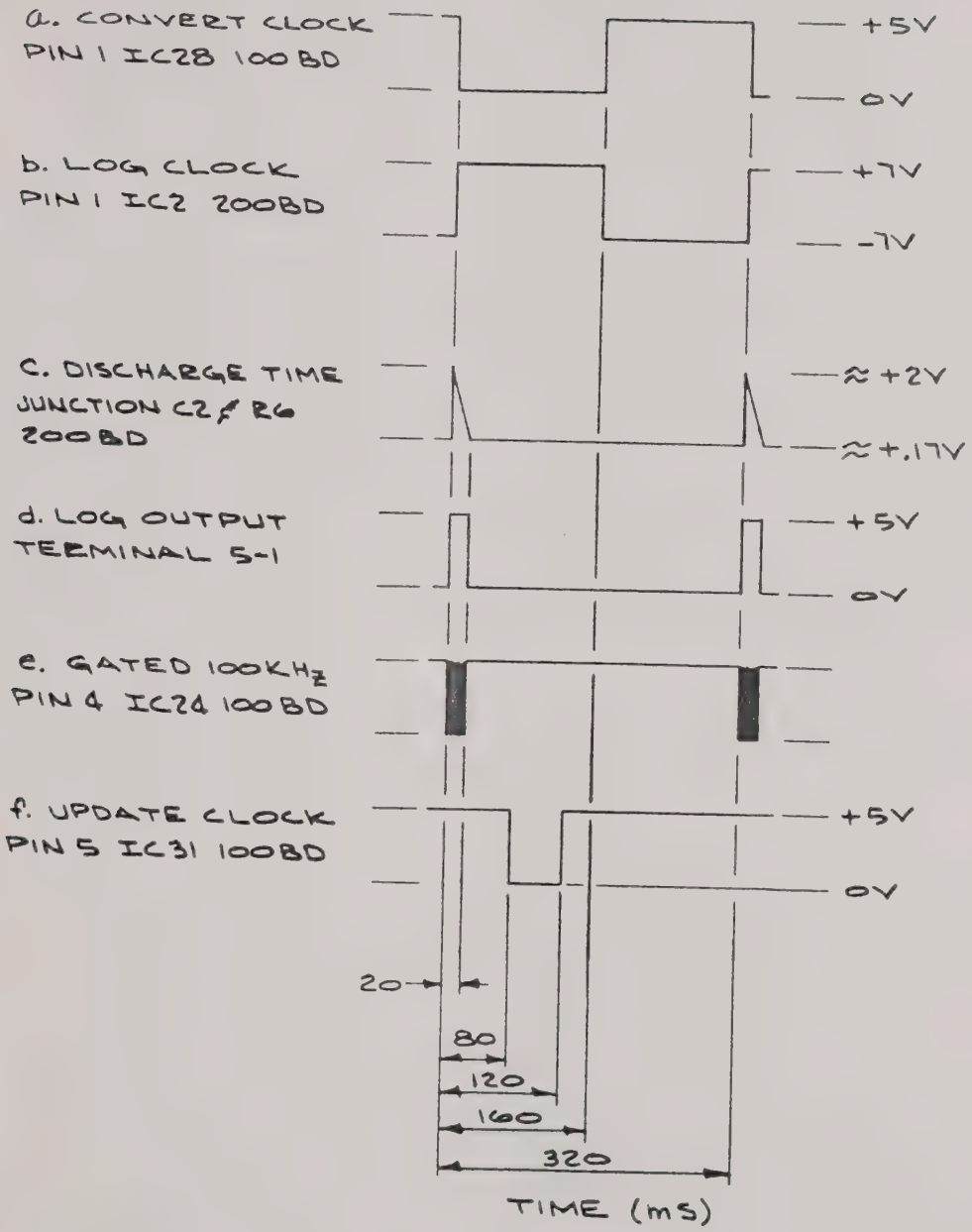


FIGURE 5-12. LOG CONVERTER TIMING DIAGRAM

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